X-5818

MAINTENANCE MANUAL

GM
GENERAL MOTORS
COACH

MODEL PD-4104

GMC TRUCK & COACH DIVISION
GENERAL MOTORS CORPORATION

STANDARD GM MOTOR COACH WARRANTY

The Manufacturer warrants each new motor coach, including all equipment or accessories (except tires) supplied by the Manufacturer, chassis or part manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited as follows:

1. To repair or, at its option, to replace for the original purchaser at Manufacturer's factory or warehouse designated by it any part or parts thereof which shall, within 180 days after delivery of such vehicle to the original purchaser or before such vehicle has been driven 25,000 miles, whichever event shall first occur, be returned to Manufacturer with transportation charges prepaid and which its examination shall disclose to its satisfaction to have been thus defective.

2. If any part or parts of said vehicle are found to be so defective and are so returned within 90 days after delivery of such vehicle to the original purchaser or before such vehicle has been driven 4,000 miles whichever event shall first occur, this warranty will include reimbursing the original purchaser for labor involved in removing and replacing such defective part or parts by paying the purchaser a labor allowance by establishing an agreed number of man hours for the replacing of such part or parts multiplied by no more than the base rate per hour of mechanical labor in effect in purchaser's own service garage at the time such labor was performed.

3. If any part or parts of said vehicle are found to be so defective and are so returned within 1 year after delivery of such vehicle to the original purchaser or before such vehicle has been driven 50,000 miles, whichever event shall first occur, the Manufacturer will sell to the original purchaser new replacement part or parts therefor at 50% of the Manufacturer's published coach operator net prices in effect at the time of shipment of the replacement part or parts to purchaser.

This warranty shall not apply to any vehicle which shall have been repaired or altered in any way so as in the judgment of the Manufacturer to affect its stability and reliability, nor which has been subject to misuse, negligence or accident, and applies to the replacement of original parts only and does not cover replacement parts. The warranty shall not apply to any vehicle which has not been maintained as recommended in the Manufacturer's maintenance manuals in which this warranty is set forth.

This warranty is expressly accepted by Buyer as being in lieu of all other understandings, representations or warranties expressed or implied and of all other obligations or liabilities of Seller with regard to such coach(es) or the use thereof by Buyer following their delivery and the Seller neither assumes nor authorizes any person to assume for it any other liability or undertaking in connection with the sale of its equipment. No warranty shall apply to any used motor coach(es) purchased by Buyer under his order and Buyer agrees to accept such coach(es) "as is".

GMC TRUCK & COACH DIVISION
GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN

MAINTENANCE MANUAL

COACH MODEL

PD-4104

GMC TRUCK & COACH DIVISION

GENERAL MOTORS CORPORATION

PONTIAC, MICHIGAN

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SECTION INDEX

Groups and sections of groups appear in manual in order listed.

INTRODUCTION

This manual contains maintenance and repair information on GM Coach Model PD-4104.

Operation of the vehicle from the standpoint of the driver is contained in a separate operating manual.

For information on Diesel engine repair, refer to current DIESEL ENGINE MAINTENANCE MANUAL.

USE OF MANUAL

MANUAL GROUPS

This manual is divided into major groups as indicated on the tab index on title page. Location of these groups can be readily found by the numerical black tab on the first page of each group which corresponds to numerical tab on this page. Some of the major groups are divided into sections, each section covering a specific unit or system, as shown in Section Index on opposite page.

PAGE AND ILLUSTRATION NUMBERS

The manual pages are numbered consecutively throughout the manual. Illustrations are numbered consecutively within each major group.

INDEXES

The Section Index on page 2 shows first page number of major groups, or first page number of each section when the major group is so divided. The alphabetical index starting on page 5 lists important items together with Manual page number references.

SPECIAL SECTIONS

Special Tool section (last section in book), lists all of the special tools referred to throughout the manual, together with names and addresses of Vendors from whom the tools may be obtained.

Lubrication Chart and all Wiring Diagrams are inserted in special pocket on inside of back cover.

Every effort has been made to make the contents of this manual accessible, readable, and accurate. Your suggestions for further improvement of this manual are invited.

GENERAL DATA

The data below includes only general information on Coach Model covered by this manual. Specific data and specifications will be found in "Specifications" section at end of each manual group. For convenience, index of general data items is shown below.

MODEL DATA

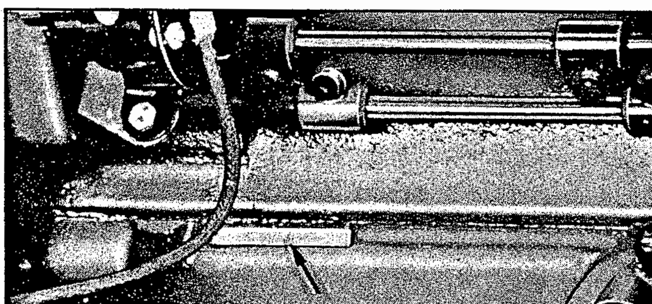
PD-4104

Wheelbase	261″
Tire Size	11.00-20
DIESEL ENGINE	
Model	6-71
Piston Displ. (cu. in.)	425.6
Bore	4¼″
Stroke	5″
S.A.E. Horsepower	43.35
Governed Engine Speed (No Load)	2125-2150 rpm (*)

(*) Depending upon specifications.

SERIAL NUMBER LOCATIONS

Delay and confusion can be avoided when correct serial numbers of vehicle are specified on parts orders and correspondence.



UPPER CORNER OF CYLINDER BLOCK NEAR GOVERNOR

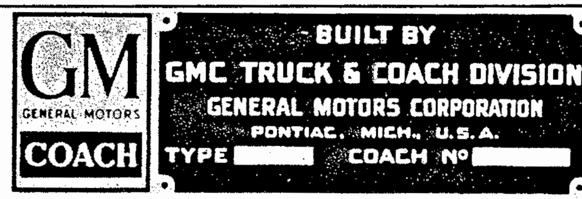
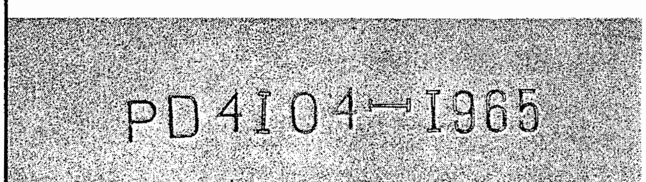
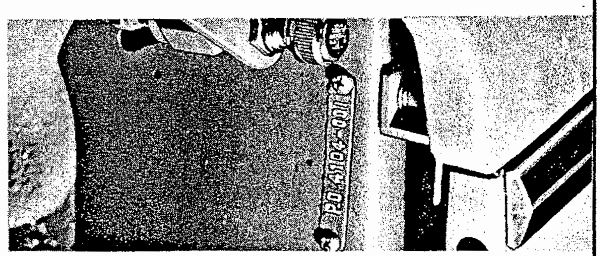


PLATE ON RIGHT-HAND SIDE OF DASH



ON BULK-HEAD INSIDE OF TOOL COMPARTMENT



DRIVER'S HEATER PANEL

TP-9261-1

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Front Axle

This group includes instructions on Front End Alignment, and Maintenance and Repair on Front Axle.

Front End Alignment

Proper front end alignment must be maintained to insure ease of steering and satisfactory tire life.

Front end alignment inspections generally fall into two groups: (1) Regular service inspections performed at periodic intervals, and (2) Inspections to determine extent of damage after a collision or severe service.

Regular service inspections are primarily concerned with toe-in, camber and caster. With proper equipment these specifications are easily checked. Any variation from these specifications will indicate: (1) need for adjustment, or (2) more thorough inspection to determine if any steering or front axle parts are bent and require replacement.

Complete front end alignment data is given under "Specifications" at the end of this section.

DEFINITION OF TERMS

WHEEL TOE-IN. Distance front wheels are closer together at front than at rear of axle (see "G" and "H," fig. 1).

WHEEL CAMBER. Amount wheels are inclined from vertical plane (see "C," fig. 1).

FRONT AXLE CASTER. Inclination of king pin from the vertical in the fore and aft direction of the vehicle (see "X," fig. 1).

KING PIN INCLINATION. The slant of the king pin toward the center of the vehicle at the top and outward at the bottom (see "D," fig. 1).

STEERING GEOMETRY. The design of the front end which causes the front wheels to stay in proper relative alignment when the wheels are turned to right or left.

FRONT END INSPECTION

Before checking front end alignment, the following front end inspection should always be made:

1. Check tires for proper inflation.
2. Check wheel installation and run-out.
3. Check wheel bearing adjustment.
4. Check tie rod and drag link ends for looseness.
5. Check king pins for looseness.

Front end alignment requires the vehicle to be level while being checked. Full weight must be on wheels with vehicle empty.

ALIGNMENT

FRONT WHEEL TOE-IN

Toe-in is measured from centers of tire tread. Measurements at both front and rear of axle (see "H" and "G," fig. 1) must be made at same height from floor.

First hoist front of vehicle and spin wheels to obtain a center line on tire treads.

Place wheels in straight ahead position.

Roll the vehicle straight ahead for several feet to where the inspection is to be made. This will remove any slack caused by looseness in the wheel bearings or steering connections.

Measure at point "H" and "G" (fig. 1). Toe-in is "G" minus "H."

To correct toe-in, refer to "Toe-in Adjustment" later in this section.

Incorrect toe-in results in excessive tire wear caused by side slippage. Unstable steering with a tendency to wander may also result.

FRONT WHEEL CAMBER

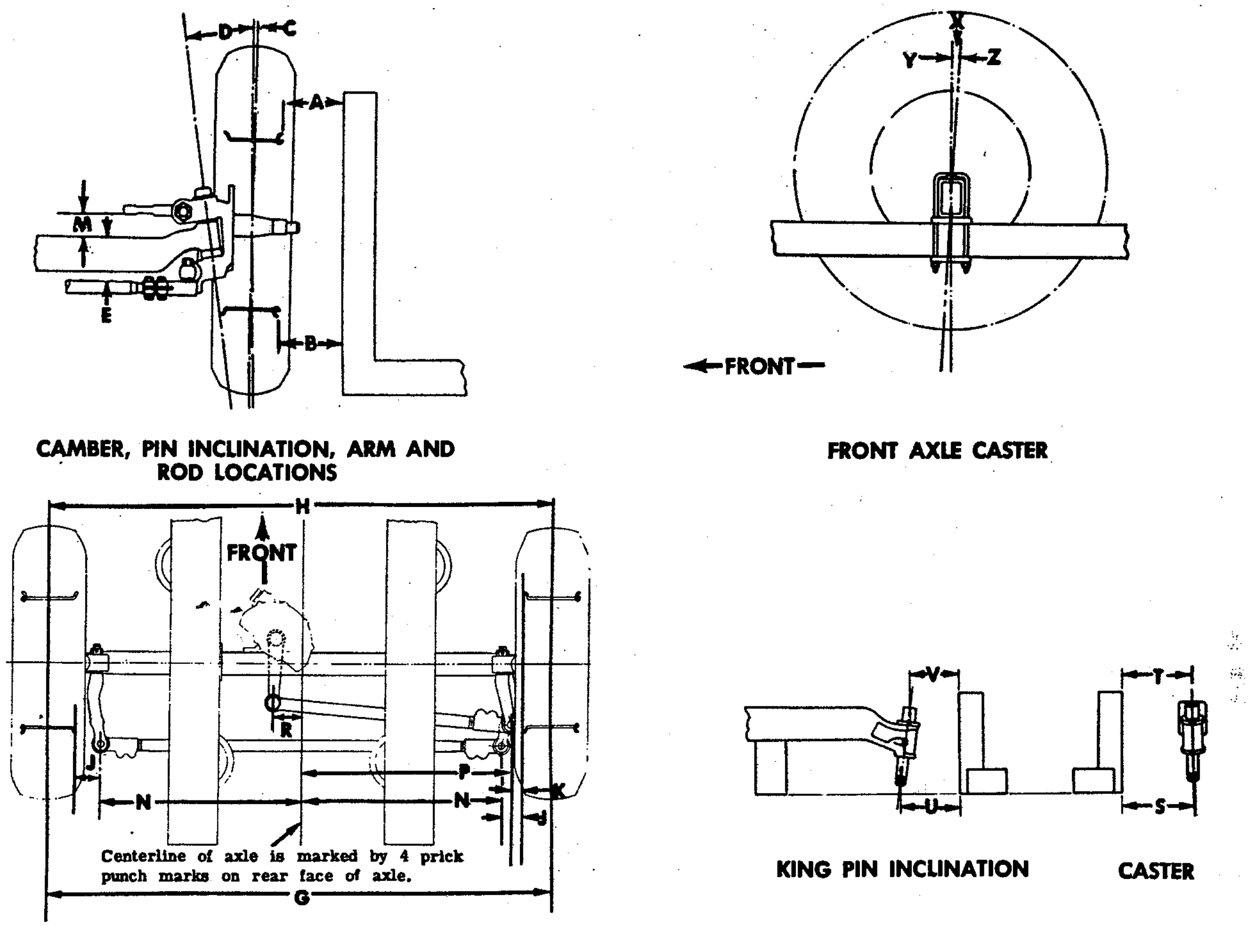
Positive Camber is outward inclination of wheels at top: Negative or Reverse Camber is inward inclination of wheels at top. This vehicle is designed with positive camber. Camber variations may be caused by wear at wheel bearings and steering knuckle bushings, or by a bent steering knuckle or sagging axle center.

In checking camber it is recommended that an accurate gauge be used. If a camber gauge is not available, readings can be taken as illustrated at "A" and "B" on chart (fig. 1). Place square as shown and measure distance between "A" and rim, and "B" and rim. Lower dimension should exceed upper dimension by amount listed in "Specifications" at end of this section. This dimension on right wheel should not vary over 3/32" from same dimension taken at left wheel.

If final camber reading is incorrect, either steering knuckle or axle center is bent. To determine which part is bent, check king pin inclination ("D," fig. 1). Camber plus king pin inclination is the INCLUDED ANGLE of steering knuckle. If included angle of knuckle varies more than 1/2 degree from value given in "Specifications," knuckle is bent.

Excessive positive camber results in irregular

FRONT END ALIGNMENT



B Minus A ....Camber (Inches)
C ....Camber (Degrees)
D ....King Pin Inclination (Degrees)
E ....Top of Tie Rod Tube Below Top of Axle
G Minus H ....Front Wheel Toe-In
J ....Centerline of Tie-Rod End Studs to Wheel Rims
K ....Centerline of Steering Arm Stud to Wheel Rim
M.................Bottom of Steering Arm Boss Above Axle

N ....Centerline of Axle to Center of Tie Rod End Studs
P ....Centerline of Axle to Center of Steering Arm End Stud
R ....Centerline of Axle to Center of Pitman Arm Stud
S Minus T ....Caster (Inches) (Measure at Front of Axle)
U Minus V ....King Pin Inclination (Inches)
X ....Caster (Degrees)
Y ....Vertical
Z ....Centerline of King Pin

Refer to "Front End Alignment Data" for Numerical Values TPM-5268

Figure 1—Front End Alignment Chart

wear of tires at outer shoulders. Negative or reverse camber causes wear at inner shoulders. Ease of steering is affected by any deviation from specified camber.

AXLE CASTER

Positive Caster is the inclination of the king pins toward rear of vehicle. Negative or Reverse Caster is the inclination of king pins toward front of vehicle. This vehicle is designed with positive caster.

Caster variations may be caused by bent axle, or tilting of side suspension supports. Precision instruments must be used to check caster angles when axle is installed in vehicle.

If caster angle does not agree with specified value, check front axle components to determine cause.

When axle is removed from vehicle, check can be made on bench as follows:

Place two uniform blocks on level surface. Rest suspension support seats on blocks. Using square, measure "S" and "T" dimensions (fig. 1) at front side of axle. "S" minus "T" equals caster in inches. If this dimension does not agree with specified value, then axle is twisted.

The purpose of caster is to provide steering stability by keeping the wheels in a straight-ahead position. Variations from specified caster values will affect steering stability causing wandering, difficulty in pulling out of curves, and a tendency toward wheel shimmy.

KING PIN INCLINATION

Precision instruments must be used to check king pin inclination when axle is installed in vehicle. When axle is removed, check can be made on bench as follows:

Place two uniform blocks on level surface, rest suspension support seats on blocks. Using square, measure "U" and "V" dimensions (fig. 1). "U" minus "V" equals king pin inclination in inches.

If axle is bent or twisted refer to "Straightening Axle Center" later in this section for corrective information.

STEERING GEOMETRY

Since the angularity of the steering arms largely controls steering geometry, checking the alignment of the steering arms and linkage is an important alignment factor.

After making all other front end alignment checks, inspect steering arms for proper installation, then measure steering arm angles as follows:

1. Position of top of tie rod tube below top of axle ("E" fig. 1).
2. Distance from bottom of steering arm to top of axle ("M" fig. 1).
3. Distance of center of tie rod end studs to edge of wheel rims ("J" fig. 1).
4. Distance from center of steering arm stud to edge of wheel rim ("K" fig. 1).
5. Distances of center of tie rod end studs to centerline of axle ("N" fig. 1).
6. Distance of center of steering arm end stud to centerline of axle ("P" fig. 1).
7. Distance of center of pitman arm end stud to centerline of axle ("R" fig. 1).

If these dimensions (see "Specifications") are not within specified values, then the steering arms or steering linkage are bent and should be replaced.

Front Axle Repair

CONSTRUCTION

Front axle assembly is Reverse Elliott type. Axles are equipped with steering knuckles constructed as shown in figure 2 or 3.

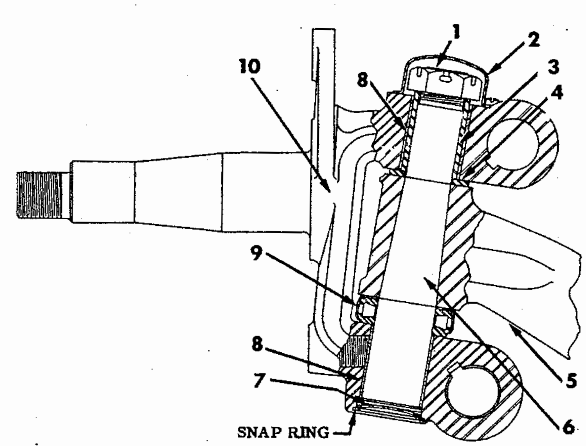
Wheel bearings, air suspension, steering gear housing, and brake parts which are mounted on front axle, are described in their respective manual sections.

Specifications and pertinent front axle service information is given in "Specifications" at end of this section.

Front axle assembly center section is a hollow rectangular tube in which dowel pins are installed to locate air suspension support. Outer ends of axle are solid forgings machined to accommodate steering knuckles and king pins.

Steering knuckles (fig. 2) are supported on solid king pins which are tapered at center section to fit snugly in tapered holes in axle outer ends. Nut installed at threaded upper end of each king pin, locks king pin bushing (3, fig. 2) against spacer (4, fig. 2) and secures king pin in axle. King pin nuts are secured by cotter pins.

Load is transmitted from axle center to steering knuckles through tapered roller thrust bearing



1 King Pin Nut
2 King Pin Cover
3 King Pin Bushing
4 Spacing Washer
5 Axle Center End
6 King Pin
7 Expansion Plug
8 Steering Knuckle Bushing
9 Thrust Bearing Assembly
10 Steering Knuckle

TP 6335-1

Figure 2—Steering Knuckle Assembly

assemblies (9, fig. 2). Covers and plugs (2 and 7, fig. 2) exclude dust and moisture from knuckle bushings and serve as lubricant seals. Steering knuckle bushings can be replaced when necessary. Stop screws installed at each end of axle center limit turning angle of front wheels.

FRONT AXLE GENERAL MAINTENANCE

INSPECTION

Following inspection operations should be performed at intervals determined by severity of service.

1. Inspect air suspension support stud nuts and U-bolt nuts. Tighten as directed in AIR SUSPENSION (SEC. 14).

2. Inspect and tighten tie rod arm and steering arm nuts. Torque specifications are shown in "Specifications" at end of this section.

3. Inspect steering arm and tie rod arm nuts for looseness. Tighten if necessary. Also inspect tie rod end stud nuts for looseness and check tie rod ends for wear.

4. When steering difficulty or abnormal tire wear indicate necessity, check front end alignment as previously instructed under "FRONT END ALIGNMENT."

5. Check stop screws and adjust when necessary. Stop screw adjustment procedure is described later.

6. Lubricate front axle parts as instructed in LUBRICATION (SEC. 13).

7. When lubricating front axle parts, observe condition of seals at steering knuckle, tie rod ends, and drag link. If seals are found to be damaged or missing, new seals should be installed immediately.

8. Periodic inspection should be made at steering knuckles to determine if excessive up-and-down movement of knuckles on king pins exists. Since excessive pounding will damage thrust bearing (9, fig. 2), the up-and-down movement of steering knuckles must be kept within prescribed limits. Shims for use in reducing clearance are available.

STOP SCREW ADJUSTMENT

Stop screws installed in front axle center limit front wheel turning angle to right and left. Stop screws must be set properly to give equal turning radius to the right and to left, as well as to limit turning angle and thereby prevent interference between front tires and other parts of coach.

Before setting stop screws, refer to STEERING GEAR (SEC. 16) and be sure pitman arm is properly installed on steering gear, and be sure steering gear drag link is properly adjusted for length. Also, make sure air suspension is pressurized.

Adjust stop screws as follows:

1. Raise front axle until front wheels are off floor.

2. Turn front wheels to extreme left. In this position there should be 1" clearance between tire and nearest point on vehicle. If necessary, turn stop screw in or out to provide 1" clearance mentioned above. Secure stop screw setting with lock nut.

3. With wheels turned to extreme left position measure and record distance from left front tire to nearest point on vehicle.

4. Turn wheels to extreme right position and measure distance from right front tire to nearest point on vehicle. If this dimension is not same as the corresponding dimension at left-hand side of coach, adjust right stop screw to provide same dimensions.

FRONT AXLE REPLACEMENT

Refer to AIR SUSPENSION (SEC. 14) for procedures necessary to remove and install front axle assembly.

Steering knuckles, king pins, and bushings may be replaced without removing front axle assembly from vehicle. However, when front axle assembly requires a complete overhaul, the assembly may be removed.

Certain preliminary inspections can be made, while axle is still mounted on vehicle, which will aid in determining the amount of repair work necessary. Check front end alignment as previously directed in "FRONT END ALIGNMENT" in this section. Inability to align front end correctly indicates that axle center or steering knuckle has been distorted, steering arms have been bent, or bushings in steering knuckle yokes are worn beyond limits. Repair procedures on such items as brakes, wheel bearings, and steering gear are covered in respective sections of this manual.

STEERING KNUCKLE REMOVAL

If desired, steering knuckles may be removed from front axle without removing front axle assembly from the vehicle.

1. Remove tie rod and ends assembly from steering tie rod arms as directed under "Tie Rod" later in this section.

2. Remove front wheels and hubs as directed in HUBS, WHEELS, AND TIRES (SEC. 19).

3. Remove brake mechanism, including brake chambers, slack adjusters and brake shoes as directed in "AIR BRAKES" (SEC. 4).

4. Remove nuts and washers from studs which attach brake spider to steering knuckle flange; then remove spider and camshaft as an assembly.

5. Remove cotter pins, nuts, and washers from steering tie rod arms, then drive arms out

of steering knuckles using a lead hammer. Also remove drag link arm and brake chamber bracket from right knuckle.

6. Remove cap screws which attach dust cap to steering knuckle, then remove dust cap and gasket. Discard gasket.

7. Remove lock ring from knuckle lower yoke, and remove plug (7, fig. 2). Remove nut from top of king pin, then using large brass drift, drive king pin out of axle and knuckle.

8. Remove knuckle and thrust bearing and spacing washer from axle. King pin bushing (3, fig. 2) will remain in knuckle upper yoke and can be lifted from yoke as soon as king pin is removed.

9. If vehicle is equipped with tachograph, remove tachograph drive mechanism as directed below:

Remove Tachograph Drive (When Used)

Key numbers in text refer to figure 3.

1. Disconnect tachograph drive cable from driven gear sleeve (10) at steering knuckle.

2. Remove driven gear sleeve (10), then remove driven gear (11) from steering knuckle.

3. Using suitable punch, remove expansion plug (9) from steering knuckle.

4. Remove drive shaft nut (7), then remove drive gear (6) from drive shaft (4).

5. Remove drive shaft (4), drive shaft spacer (1), and shims (2) from steering knuckle.

6. Remove key (8) from keyway in drive shaft.

INSPECTION AND REPAIR

CLEANING PARTS

Wash steering knuckle parts in cleaning solution, being sure to remove all dirt and lubricant. If necessary, soak thrust bearings in cleaner until all old lubricant is dissolved; then slush bearing in cleaning solution until all grit is removed from races.

STEERING KNUCKLES

After steering knuckles have been cleaned thoroughly, examine knuckles for distortion, damage, cracks or fractures. If Magna Flux inspection equipment is available, use this method to inspect steering knuckles and king pins for minute cracks, checks, or fractures, which otherwise would not be visible.

KNUCKLE BUSHING REPLACEMENT

Steering knuckle bushings should be replaced if inspection reveals that they are scored, worn, or otherwise damaged. Bushing dimensions are given in "Specifications." Replace bushings if not within limits.

Removal

1. Clamp steering knuckle securely in vise equipped with soft jaws.

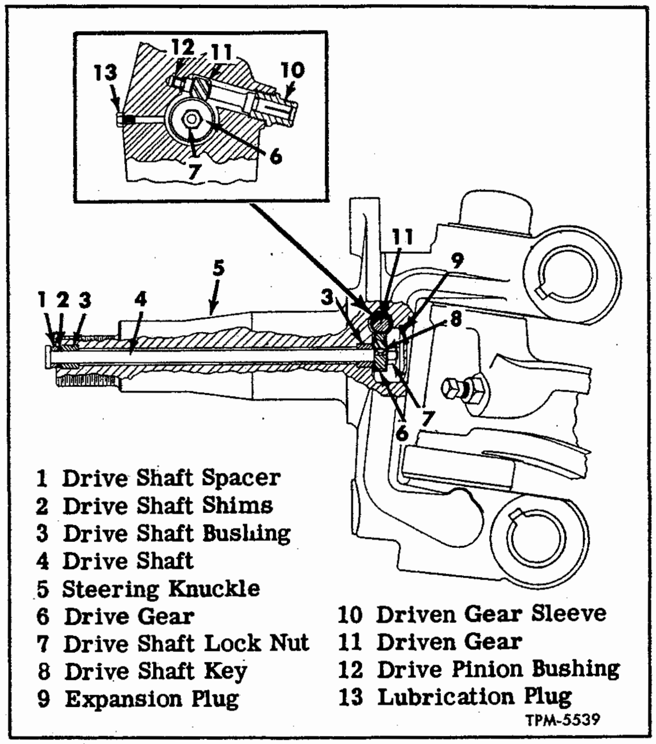


Figure 3—L.H. Steering Knuckle With Tachometer Drive

2. Thread tap of suitable size into bushing if bushing driver is not available.

3. Using soft metal rod slightly smaller than bushing and long enough to extend about 1-1/2" through opposite knuckle yoke, drive tap and bushing out of knuckle bore.

4. Repeat process to remove remaining steering knuckle bushing.

Installation

1. Clean the steering knuckle bushing bores, then round off all sharp edges of new bushings slightly.

2. Position bushing so that oil hole in bushing will line up with lubrication fitting hole in steering knuckle yoke, and so that bushing will enter knuckle bore straight when pressed into yoke.

3. Press bushing into knuckle bore, using arbor press or suitable driver. DO NOT DRIVE BUSHINGS WITH HAMMER.

4. Burnish or ream bushings to diameter given in "Specifications" at end of this section, using either a two step reamer or a burnishing tool. Tool used must have a long pilot bar, or be long enough to finish both upper and lower bushings at the same time.

5. Clean cuttings out of oil grooves, then round off all sharp edges in grooves.

TACHOGRAPH DRIVE INSPECTION

Inspect drive and driven gears for worn or chipped teeth. Inspect drive shaft, drive shaft

FRONT AXLE REPAIR

bushings, and drive pinion bushings for wear. Refer to "Specifications" for bushing diameter.

TACHOGRAPH BUSHING REPLACEMENT (Fig. 3)

Drive Pinion Bushing Removal

1. Pack bushing and space in back of it with heavy water pump grease.

2. Make a punch with parallel sides to a size that will just slip into the bushing.

3. Insert punch in the end of bushing and strike punch several hard blows with a hammer. Hydraulic action will force old bushing out.

Drive Pinion Bushing Installation

Install new bushing in knuckle making sure it is driven all the way down against the shoulder, otherwise there will not be sufficient end clearance between driven gear and driven gear sleeve.

Drive Shaft Bushing Removal

Using a split punch or suitable tool remove two drive shaft bushings from steering knuckle spindle.

Drive Shaft Bushing Installation

Press bushing into steering knuckle spindle using a press or suitable driver. NOTE: The bushings must be installed with grooved ends out to provide an oil passage between drive gear and bushing at inner end and between shims or spacer and bushing at the hub cap end. Refer to "Specifications" at end of this section for bushing diameter.

KING PIN

Check diameter of king pin, at upper and lower bearing surfaces, against dimensions given in "Specifications" at end of this section. If wear exceeds limits given, replace with new king pin.

King pins should also be inspected for minute cracks or other damage. Any burrs or grooves may be honed out provided such honing will not reduce diameter of pin below limits given in "Specifications" at end of this section.

King pin bushings (3 and 8, fig. 2) should be inspected for damage or wear.

THRUST BEARING

Examine thrust bearings for excessive wear, pitting, or other damage. If these conditions are evident, discard bearing and install new part when assembling axle. If bearing retainers are bent or damaged, bearings should be replaced.

AXLE CENTER

There are two conditions which, if either exists, will necessitate replacement of axle center.

1. If king pin holes in axle center ends are worn to such an extent that a new pin fits loosely, axle center must be replaced.

2. If axle center has been twisted or bent more than 5 degrees from original shape, the center should be replaced. As a general rule, when an extreme bent condition exists, minute fractures which may be invisible will occur, and failure under ordinary operating conditions will result.

CHECKING AXLE CENTER

Check axle center for twist with alignment instruments. If equipment is available, use Magna Flux method to check axle center for minute fractures.

STRAIGHTENING AXLE CENTER

The straightening of axle forgings must be performed by mechanics who are thoroughly familiar with such operations and the use of special straightening tools. ALWAYS STRAIGHTEN FORGINGS COLD -- UNDER NO CIRCUMSTANCES SHOULD HEAT BE APPLIED. Application of heat to facilitate straightening weakens the material strength of all forgings.

STEERING KNUCKLE INSTALLATION

The importance of cleanliness when assembling steering knuckle parts cannot be overstressed. If king pins, bushings and tachograph drive parts (when used) are installed with particles of dirt or metal between bearing surfaces, excessive wear will result necessitating premature replacement of parts. If vehicle is equipped with tachograph, install drive mechanism in steering knuckle before assembling steering knuckle to axle.

INSTALL TACHOGRAPH DRIVE (If Used)

Key numbers in text refer to figure 3.

1. Coat driven gear (11) and driven gear sleeve (10) with lubricant specified in LUBRICATION (SEC. 13), then install driven gear and driven gear sleeve in steering knuckle.

2. Position spacer (1) and shims (2) on drive shaft, using same thickness of shims that were removed. To make a check to provide 0.003" to 0.012" end play, install drive shaft in steering knuckle spindle less drive shaft key. Install drive gear (6), then install a plain 5/16 nut on drive shaft and torque nut to 6 to 9 ft.-lbs.

3. Check drive shaft end play. If not within 0.003"-0.012", remove shaft and add or remove shims (2) as required. NOTE: Shim thicknesses are shown in "Specifications."

4. Fill cavity between drive shaft bushings (3) with lubricant recommended in LUBRICATION (SEC. 13) in this manual.

5. Install drive shaft (4), spacer (1), and shims (2) in steering knuckle spindle. Install drive shaft key (8) in drive shaft.

6. Install tachograph drive gear (6) with

smoothest side of gear toward bushing (3).

7. Install new lock nut (7) on drive shaft (4). NOTE: Lock nut has an oval appearance when viewed from one end; the opposite end of nut should be started on drive shaft. Torque nut 6 to 9 ft.-lbs. Recheck end play to make sure it is within limits.

8. Install new expansion plug (9) in drive gear cavity and stake plug securely in three places. Lubricate tachograph assembly. Refer to LUBRICATION (SEC. 13) of this manual.

Install steering knuckles and king pins as directed below:

INSTALL STEERING KNUCKLE

Key numbers in text refer to figure 2.

1. Position steering knuckle (10) on axle center end (5), then slide thrust bearing assembly (9) into place between lower face of axle center and steering knuckle lower yoke. Make sure retainer is on top of bearing with lip of retainer down. Align king pin holes in steering knuckle yokes with king pin hole in axle center end.

2. With axle center held rigidly, place a jack under knuckle yoke and raise knuckle sufficiently to take up all clearance between lower yoke, thrust bearing, and lower face of axle center end.

3. Check clearance between top face of axle center end and lower face of steering knuckle yoke, then select shim and spacing washer (4) combination which will reduce clearance to limits given in "Specifications" at end of this section. Shim and spacing washer thicknesses available are also given in "Specifications."

4. Make certain king pin hole in axle center (5), king pin (6), and nut (1) are carefully cleaned and dry. King pin nut (1) should screw on king pin freely without binding in any manner. These precautions should be taken to assure king pin being securely locked in place when installation is completed.

5. Insert king pin (6) through bottom yoke of steering knuckle (10), then drive king pin into place with lead hammer.

6. Place king pin bushing (3) over threaded end of king pin (6), then press bushing into place. Be sure king pin bushing is installed squarely on king pin.

7. Make sure threads on king pin nut are clean and dry, then install king pin nut (1). Tighten nut, with torque wrench, to minimum torque given in "Specifications" at end of this section, then tighten nut until next castellation on nut lines up with cotter pin hole through king pin. Install new cotter pin, full size of cotter pin hole.

8. Position new dust cap gasket on steering knuckle upper yoke, place dust cap (2) on gasket, then secure cap with attaching screws.

9. Install new plug (7) in lower yoke, then install lock ring to retain plug. Install plug with concave side toward lock ring so edge of plug contacts ring.

10. Check action of steering knuckle by hand. If there is excessive binding or tightness, steering knuckle will have to be disassembled as previously described in this section. Recheck all parts until cause of binding is found.

11. Place arm keys in keyways machined in steering arm and steering tie rod arms. After making sure tapered holes in knuckle yoke and tapered ends of arms are clean and dry, insert arms in yokes. Place lock washers and nuts on steering tie rod arms, tighten nuts to minimum torque given in "Specifications" at end of this section, then tighten nut until next castellation on nut lines up with cotter pin hole in arm. Install new cotter pin full size of hole. Place brake chamber bracket on steering arm, using dowel in steering knuckle upper yoke to locate bracket correctly, then install new lock washer and nut. Tighten nut to minimum torque given in "Specifications" at end of this section; then tighten nut until next castellation on nut lines up with cotter pin hole in arm. Install new cotter pin.

12. Install brake mechanism as instructed in BRAKES (SEC. 4).

13. Install wheels and hubs as instructed in HUBS, WHEELS, AND TIRES (SEC. 19).

14. Install tie rod assembly with the tie rod end with right-hand thread toward right-hand side of axle.

TIE ROD

Tie rod assembly used is three-piece type comprised of a rod and two end assemblies. Tube is threaded into ends and locked with clamp bolts. Right- and left-hand threads are provided on tie rod to facilitate toe-in adjustment.

Tie rod ends (fig. 4) are constructed to automatically compensate for wear on bearing surfaces.

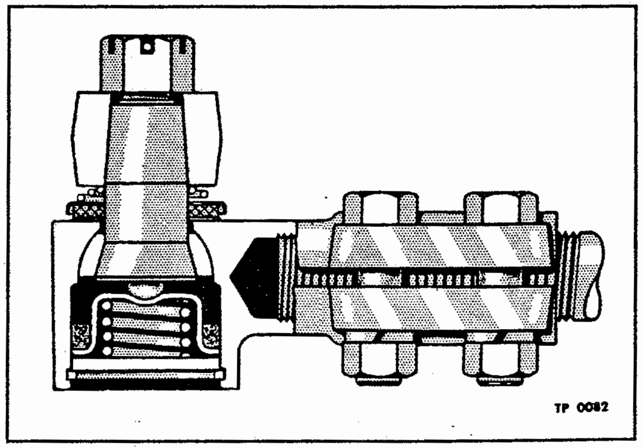
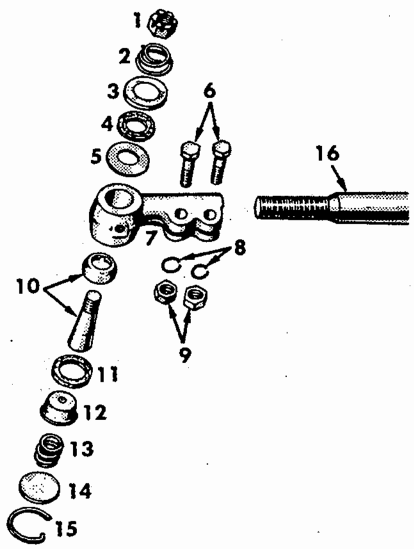


Figure 4—Tie Rod End Construction



1 Tie Rod End Stud Nut
2 Dust Cover Retainer Spring
3 Tie Rod End Dust Cover
4 Tie Rod End Dust Seal
5 Tie Rod End Dust Seal Retainer
6 Tie Rod End Clamp Bolt
7 Tie Rod End Body
8 Clamp Bolt Lock Washer
9 Clamp Bolt Nut
10 Tie Rod End Stud and Bearing Assembly
11 Tie Rod End Oil Retaining Felt
12 Tie Rod End Stud Seat
13 Tie Rod End Stud Seat Spring
14 Tie Rod End Plug
15 Tie Rod End Plug Lock
16 Tie Rod Tube

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Figure 5—Tie Rod End Components

Tie rod end stud is held in contact with bearing surfaces by tension of spring which holds seat firmly against inner end of stud. Tie rod end parts are held in place by an end plug retained by lock ring.

Normal wear on bearing surface in tie rod end, will cause increase in overall height of assembly. If excessive play is noted, the parts which are worn must be replaced, or a new tie rod end assembly must be installed.

TOE-IN ADJUSTMENT

Tie rod adjustment is necessary whenever front wheel toe-in is found to be incorrect. (Refer to "FRONT END ALIGNMENT" previously in this section for method of measuring toe-in.) Adjust tie rod as follows:

1. Set front wheels in straight-ahead position.
2. Loosen clamp bolts at both ends of tie rod.
3. Use pipe wrench to turn tie rod tube as required to correct toe-in measurement.
4. When adjustment is completed, make sure tie rod ends are in same plane, then tighten clamp bolts.

TIE ROD DISASSEMBLY (Fig. 5)

1. Remove cotter pins and nuts from tie rod ends, support steering arm to prevent bending, then drive tie rod end tapered stud out of steering arm. Remove spring (2), dust cover (3), seal (4), and retainer (5) from stud.
2. Loosen clamp bolts, then remove tie rod end assembly from tube.
3. Pry end plug lock (15) out of groove in body (7); then remove plug (14), seat and spring (12 and 13) and grease retainer (11). Stud and bearing assembly can now be removed from body.

INSPECTION

Clean all parts of tie rod and then inspect parts for wear and check tension of spring (13, fig. 3). Discard worn parts and replace spring if broken or weak.

ASSEMBLING TIE ROD ENDS (Fig. 5)

1. Lubricate parts with lubricant specified in LUBRICATION (SEC. 13) before assembling tie rod ends.
2. Insert end stud and bearing assembly (10) into tie rod end body (7), place oil retaining felt (11) over end of end stud seat (12), then position seat (12) in body (7).
3. Place stud seat spring (13) inside seat (12), lay end plug (14) on spring, then compress spring (13) and install end plug lock (15) in groove in body (7).
4. Thread tie rod end assemblies on tie rod tube (16), install clamp bolts (6), new lock washers (8), and nuts (9). Do not tighten nuts (9) at this time.
5. Carefully clean tapered portion of tie rod end studs (10), then install dust seal retainers (5), dust seals (4), dust covers (3), and dust retainer springs (2) on end studs in order named.
6. Clean tapered holes in steering tie rod arms, position complete tie rod assembly on steering arms, then thread stud nuts (1) on end studs (10). Tighten stud nuts to minimum torque given in "Specifications" at end of this section, then tighten nuts until next castellation on nut lines up with cotter pin holes in studs. Install new cotter pin full size of hole.

Specifications

FRONT END ALIGNMENT DATA

(Refer to Alignment Chart - Figure 1)

POINTS ON CHART		
B Minus A	Wheel Camber (Inches)	11/32 on 20" Wheel Rim
B Minus A	Wheel Camber (Inches)	21/64 on 19" Wheel Rim
C	Wheel Camber (Degrees)	1
D	King Pin Inclination (Degrees)	8
E	Top of Tie Rod Tube Below Top of Axle (Inches)	4-11/16
G Minus H	Toe-In (Inches)	0-1/16"
J	Centerline of Tie Rod Studs to Edge of Wheel Rim (Inches)	2-7/8
K	Centerline of Steering Arm Stud to Edge of Wheel Rim (Inches)	
	Manual Steering	1/16
	Power Steering	2-1/16
M	Bottom of Steering Arm Boss Above Axle (Inches)	
	Manual Steering	4-15/16
	Power Steering	1-3/4
N	*Centerline of Axle to Center of Tie Rod End Studs (In.)	31-9/16
P	*Centerline of Axle to Center of Steering Arm End Studs (In.)	
	Manual Steering	34-15/32
	Power Steering	32-7/16
R	*Centerline of Axle to Center of Pitman Arm Stud (In.)	5-3/16
S Minus T	Caster (Inches) Measured at Front of Axle	9/16
U Minus V	King Pin Inclination (Inches)	1-1/2
X	Caster (Degrees)	3
	Front Wheel Track at Ground (Inches)	78-7/8

* Centerline of Axle is Prick-Punched on Face of Axle Beam.

FRONT AXLE SPECIFICATIONS

STEERING KNUCKLE	
Spindle Diameter	
At Inner Wheel Bearing	2.5613-2.5623"
At Outer Wheel Bearing	2.1243-2.1248"
Steering Knuckle Bushings	
Inner Diameter	1.7965-1.7975"
Length	2.1775-2.1975"
King Pin Bushings	
Inner Diameter	1.310-1.311"
Outer Diameter	1.7930-1.7940"
Length	2-15/32"
KING PIN	
Diameter at Top of Pin	1.3085-1.3095"
Diameter at Bottom of Pin	1.7930-1.7940"
Length (Overall)	10-3/4"
FITS AND TOLERANCES	
Clearance Between	
King Pin Bushing and Knuckle Bushing	0.0025-0.0045"
King Pin and Lower Knuckle Bushing	0.0025-0.0045"
King Pin and King Pin Bushing	0.001-0.003"
Steering Knuckle Thrust	0.015" Maximum
Thrust Adjustment	With Shims and Spacers
Shim Thickness Available - 1@	0.015"
Spacing Washer Thickness Available	0.093", 0.125", & 0.156"
TORQUE SPECIFICATIONS	
King Pin Nuts	300-400 ft. lbs.
Steering Arm Nuts	500-550 ft. lbs.
Steering Tie Rod Arm Nuts	500-550 ft. lbs.
Tie Rod End Stud Nuts	250-300 ft. lbs.
TIE ROD END	
End Stud Seat Spring Free Length	1-1/4"
Resistance When Compressed to 7/8"	235-265 lbs.
Solid Height	13/16"
AXLE CENTER	
Maximum Allowable Twist End to End	1/2°

TACHOGRAPH DRIVE SPECIFICATIONS

Drive Shaft Shim Thickness	0.010" and 0.0312"
Drive Pinion Bushing	
Inside Diameter	0.2530"-0.2550"
Outside Diameter	0.3125"-0.3145"
Length	11/32"
Drive Shaft Bushing	
Inside Diameter (Line Ream at Assembly)	0.3775"-0.3785"
Outside Diameter	0.688"-0.689"
Length	1/2"
Drive Shaft Spacer	
Outside Diameter	5/8"
Length	1/4"

Rear Axle

Rear axle is full-floating type, using a one piece axle housing with housing bowl cover welded to housing. Housing bowl is located to the left of axle center line.

As shown in figure 1, drive pinion assembly is mounted at an angle to drive gear, thus increasing the tooth contact area between drive gear and drive pinion gear teeth. Drive is transmitted from transmission angle drive unit through propeller shaft to spiral bevel gears, axle housing, and then to vehicle underframe through upper and lower radius rods.

Differential and drive pinion assemblies are both provided with facilities for adjustment of bearings and gear tooth contact.

DIFFERENTIAL CARRIER

Differential assembly, drive pinion, and pinion cage assembly, are mounted in differential carrier. After axle shafts have been removed, and propeller shaft has been disconnected, differential carrier can be removed for inspection and adjustment without removing axle housing from vehicle.

DIFFERENTIAL

Conventional four-pinion type differential is carried in two-piece case mounted on tapered roller bearings. Bevel drive gear is bolted to flanged half of differential case. Drive gear and pinion are furnished in matched, lapped sets, and should always be installed as such to assure satisfactory operation.

Thrust washers are used between differential side gears and case and between differential pinions and case. A replaceable bronze bushing is broached into differential pinions. Differential case halves are held together with special bolts and slotted nuts, locked in place with lock wire.

DIFFERENTIAL SIDE BEARINGS

Differential is supported in tapered roller bearings which take thrust as well as radial loads. Bearings are mounted in machined supports in differential carrier with thrust loads taken by adjusting rings threaded into carrier supports and bearing caps. Threaded adjusting rings provide a means of adjusting bearing pre-load also for adjusting gear tooth contact and backlash. Adjusting rings bear against bearing cups and are locked in position by adjusting ring locks bolted to each bearing cap.

PINION AND CAGE

Bevel drive pinion is installed at an angle in differential carrier. Pinion is straddle mounted in two opposed tapered roller bearings at outer end, and one straight roller bearing at inner end.

Tapered roller bearing cups installed in pinion cage (fig. 1), are separated by a machined shoulder in pinion cage. Pinion bearings are adjusted on shaft by selecting correct spacer combination as described later in this section, under "Pinion and Cage Assembly." Straight roller bearing at inner end of drive pinion, is secured in place with a snap ring.

Shims of various thicknesses are used between pinion cage and differential carrier to adjust gear tooth contact and backlash.

Pinion shaft and cage assembly cannot be removed from carrier until differential assembly has been removed from carrier.

AXLE SHAFT AND HOUSING

Axle shafts are full floating type. Drive flange at outer end is attached to hub by studs, nuts, and tapered dowels, inner end of shaft is splined to differential side gear.

Axle housing is one-piece design with differential located off center. Housing is equipped with outer end tubes which are threaded to accommodate wheel bearing adjusting nuts.

MAINTENANCE ON VEHICLE

The following maintenance operations should be accomplished at regular inspection and lubrication intervals.

LUBRICATION

Lubrication checking and draining intervals and filling instructions, also type of lubricant and capacity is given in LUBRICATION (SEC. 13) of this manual.

Examine pinion oil seal, axle shaft flange and carrier to housing gaskets for evidence of lubricant leakage and correct as necessary.

MOUNTING

Maintenance of axle mounting on vehicle consists primarily of a regular and systematic

REAR AXLE

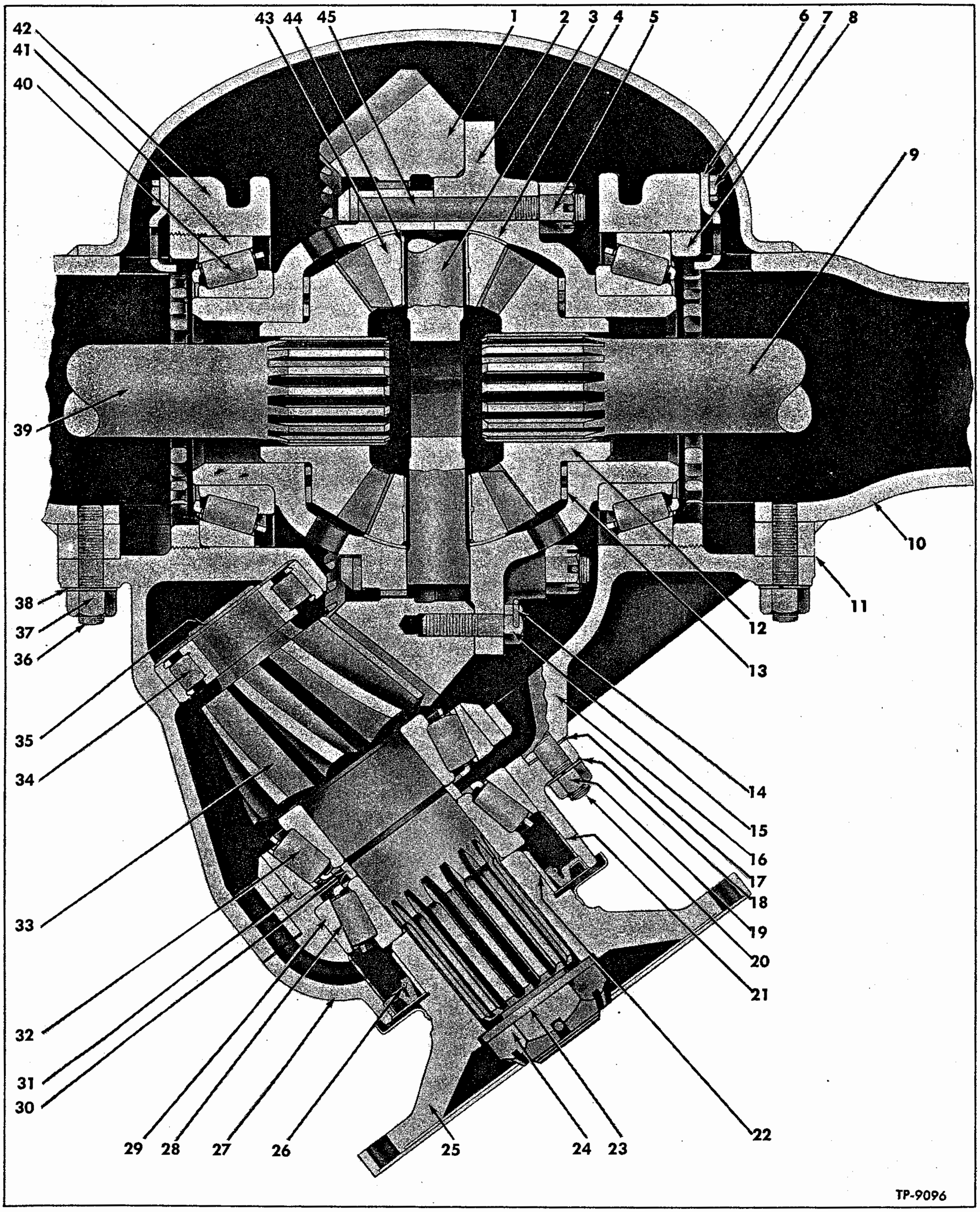


Figure 1—Rear Axle

1 Drive Gear	17 Pinion Cage Shims	31 Inner Bearing Cup
2 Differential Case	18 Lock Washer	32 Drive Pinion Inner Bearing Cone
3 Differential Spider	19 Pinion Cage Stud Nut	33 Drive Pinion
4 Differential Pinion Thrust Washer	20 Pinion Cage Stud	34 Drive Pinion Inner Bearing
5 Differential Case Bolt Nut	21 Pinion Oil Seal Spacer	35 Inner Bearing Retainer Ring
6 Adjusting Ring Lock	22 Oil Seal Sleeve	36 Differential Carrier Stud
7 Adjusting Ring Lock Bolt	23 Drive Pinion Nut Washer	37 Differential Carrier Stud Nut
8 Bearing Adjusting Ring	24 Drive Pinion Nut	38 Lock Washer
9 Axle Shaft (Right)	25 Propeller Shaft Flange	39 Axle Shaft (Left)
10 Axle Housing	26 Oil Seal Assembly	40 Differential Side Bearing Cone
11 Differential Carrier Gasket	27 Pinion Cage	41 Differential Side Bearing Cup
12 Differential Side Gear	28 Drive Pinion Outer Bearing Cone	42 Differential Bearing Cap
13 Side Gear Thrust Washer	29 Outer Bearing Cup	43 Differential Pinion
14 Drive Gear Bolt Lock Wire	30 Drive Pinion Bearing Spacer	44 Differential Pinion Bushing
15 Drive Gear Bolt		45 Differential Case Bolt
16 Differential Carrier		

Captions for Figure 1

inspection of air suspension units and radius rods as directed in AIR SUSPENSION (SEC. 14).

AXLE SHAFT FLANGE

Axle shaft flanges are retained to hubs with stud nuts, lock washers, internal-tooth lock washers, and split tapered dowels. The studs must be straight and dowels of correct taper must be used. There should always be a slight clearance between nuts and driving flange when nuts are drawn up tight.

Whenever inspection shows that no clearance exists between nut and flange this indicates that excessive wear exists at tapered dowels, studs, or tapered holes in drive flange.

If stud nuts are not tightened to recommended torque, play at flange and broken or worn studs will result and damaged parts must be replaced.

AXLE OVERHAUL

Rear axle may be disassembled while housing remains installed in vehicle if proper equipment is available for handling differential carrier assembly. Information on suspension, propeller shaft, brakes, hubs, bearings, wheels, and tires will be found in respective sections of this manual.

AXLE SHAFT REPLACEMENT

The following procedures for removal and installation of axle shafts is applicable regardless whether the axle assembly is removed or installed on the vehicle.

REMOVAL

1. Remove nuts and washers from ten hub studs.
2. Loosen lock nut at each of the three puller screws. Strike center of flange with a lead hammer to loosen flange and dowels from studs.
3. Tighten three puller screws evenly and alternately until flange is pulled from hub studs. Withdraw axle shaft from housing, then remove gasket from hub or flange.

INSTALLATION

1. Install and adjust wheel hubs and bearings as directed in WHEELS, HUBS, AND TIRES (SEC. 19).
2. Install new gasket over hub studs. NOTE: Observe that oil seal assembly also wiper and cork assembly are installed at outer side of hub.
3. Dip splined end of axle shaft in rear axle lubricant, then insert shaft into housing, guiding shaft into side gear and at same time align flange holes with hub studs. When studs and flange holes are in alignment, push axle shaft into place.
4. Install split tapered dowels, external toothed lock washers, and nut on four studs at tapered holes in flange, also install lock washers and nuts at remaining six studs. Tighten nuts alternately and evenly to 75-100 ft.-lbs. torque.
5. Tighten three set screws so to exert a slight outward pressure on drive flange; then tighten lock nut.

AXLE REPLACEMENT

Complete instructions for removal and install-

ation of rear axle assembly will be found in AIR SUSPENSION (SEC. 14).

DISASSEMBLY

The following instructions provide procedures for complete disassembly, cleaning, inspection, repair, and reassembly of rear axle. Axle housing may be checked for bent condition before axle assembly is removed from coach. The following repair procedure is based on the operations necessary when axle is removed from coach.

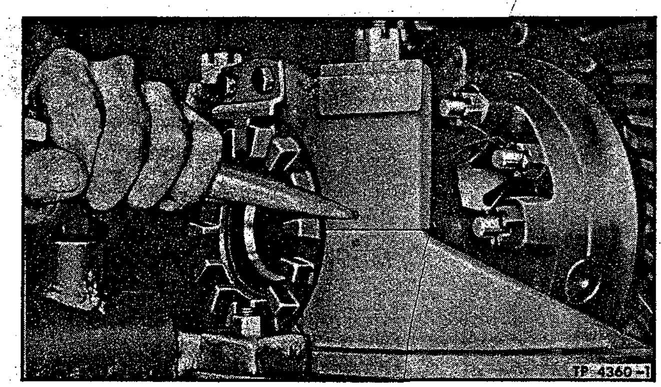


Figure 2—Bearing Cap Alignment Marks (Typical)

Before and during disassembly operations, perform following inspections and check all adjustments to determine adjustments and repairs required. KEY NUMBERS IN TEXT REFER TO FIGURE 1, UNLESS OTHERWISE INDICATED.

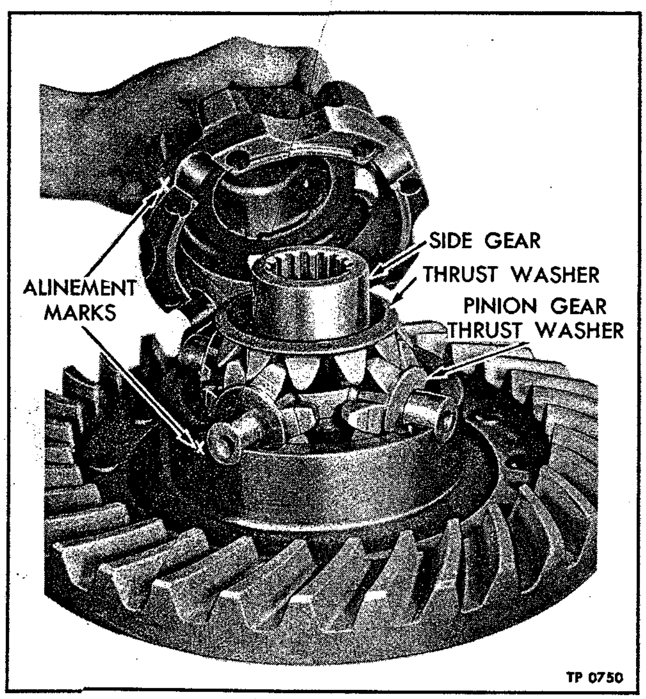


Figure 3—Differential Case Alignment Marks

AXLE HOUSING CHECK

At regular inspection intervals, or if conditions indicate that rear axle housing might be bent, housing should be checked, using the following method. This check can be made before or after axle is removed from coach to determine if housing is sprung. Conventional camber and toe-in gauges can be used to perform inspection.

1. Support axle in level position using blocks at each support beam; then check rear wheel bearings for proper adjustment as instructed in HUBS, WHEELS, AND TIRES (SEC. 19).

2. Check run-out at each rear wheel and replace wheels having run-out in excess of 3/32".

3. Check for toe-in and camber at rear wheels. Rear wheels should not toe-in or out more than 1/8", and camber should be zero, plus or minus 1/4 degree. If measurements are not within the above dimensions, bent or sprung axle housing is indicated. Make notation of the existing conditions for use when making corrections later.

4. In cases where bent axle housings are indicated, further checks to determine exact location of bend should be made after differential carrier has been removed, then necessary steps taken to correct the condition. Any straightening should be done with axle housing COLD, UNDER NO CIRCUMSTANCES SHOULD HEAT BE APPLIED.

DIFFERENTIAL CARRIER REMOVAL

1. Remove axle shafts as previously instructed under "Axle Shaft Replacement" in this section.

2. Remove nuts, lock washers and bolts attaching propeller shaft to rear axle.

3. Remove drain plug and drain lubricant from housing.

4. Remove stud nuts (37) and lock washers (38) from differential carrier studs (36).

5. Be certain that differential carrier is supported solidly, then proceed to pull complete carrier assembly out of housing.

DIFFERENTIAL REMOVAL

1. Remove lock wire from adjusting ring lock retaining bolts (7). Remove bolts, then remove adjusting ring lock (6).

2. Remove nuts from differential side bearing cap studs. Make certain that bearing caps (42) and carrier are marked (fig. 2) before removal; then remove side bearing caps (42). Remove side bearing adjusting rings (8). Lift differential assembly with cups (41) from carrier.

DIFFERENTIAL DISASSEMBLY

1. Mark both halves of differential case (2) so halves may be reassembled in original positions (fig. 3).

2. Remove side bearings (40) from each half of case, using suitable bearing puller in manner illustrated in figure 4.

3. Remove lock wire and nuts (5) from bolts (45) which hold the two halves of differential case (2) together; then separate halves of case.

4. Remove side gears (12), thrust washers (13), spider (3), pinions (43), and thrust washers (4) from differential case.

5. If either drive gear (1) or drive pinion (33) are worn or damaged, both must be replaced as a matched set. Never replace drive pinion or drive gear separately.

PINION CAGE REMOVAL
AND DISASSEMBLY

1. Remove nuts (19) and lock washers (18) which secure pinion cage (27) on differential carrier (16).

2. Install two puller screws (1/2" - 13 x 2-1/2") and tighten alternately and evenly to pull cage (27) out of carrier; then noting quantity, remove shim pack (17) from pinion cage studs (20). Tie shims (17) together so same shim pack may be used at reassembly.

3. Remove retainer ring (35) which secures inner bearing (34) on drive pinion (33) then remove inner bearing from drive pinion with a suitable puller.

4. Clamp pinion in vise equipped with soft jaw plates. Remove cotter pin, nut (24), and washer (23) from drive pinion (33).

5. Place cage and drive pinion assembly in an arbor press and press drive pinion (33) out of flange (25) and pinion cage. Outer bearing (28) will remain in pinion cage.

6. Remove bearing adjusting spacer (30) from drive pinion (33). With bearing puller remove inner bearing (32) from drive pinion (33) (fig. 5).

7. Remove oil seal (26) assembly and oil seal spacer (21) from pinion cage. If bearing cups (29 and 31) are to be removed from cage (27) use brass drift or bearing cup puller.

CLEANING, INSPECTION, AND REPAIR

CLEANING BEARINGS

The importance of proper bearing cleaning cannot be over-emphasized. Bearings should always be cleaned separately from other rear axle parts. When cleaning bearings, be sure to perform all of the following steps.

1. Soak differential and drive pinion bearings in clean kerosene, Diesel fuel oil, or other cleaning solvent. Gasoline, which is sometimes used as a bearing cleaner should not be used. Also, bearings should never be placed in a hot solution tank for cleaning.

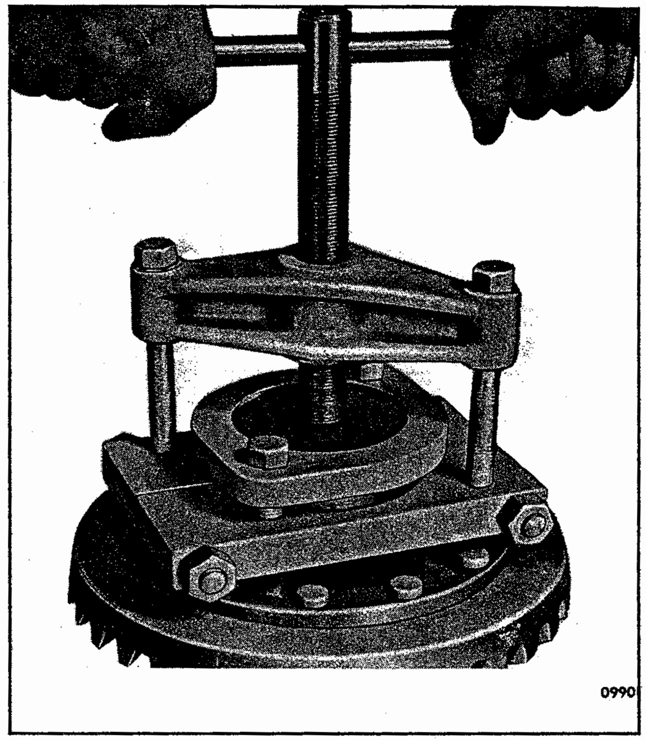


Figure 4—Differential Bearing Removal (Typical)

2. After old lubricant is loosened, hold bearing races so that bearings cannot rotate, then brush bearings with soft bristled brush until all grit and dirt has been removed.

3. Rinse bearings in clean fluid; then, while holding races, blow dry with compressed air. Be sure air stream is moisture free.

4. Inspect bearings as instructed under "In-

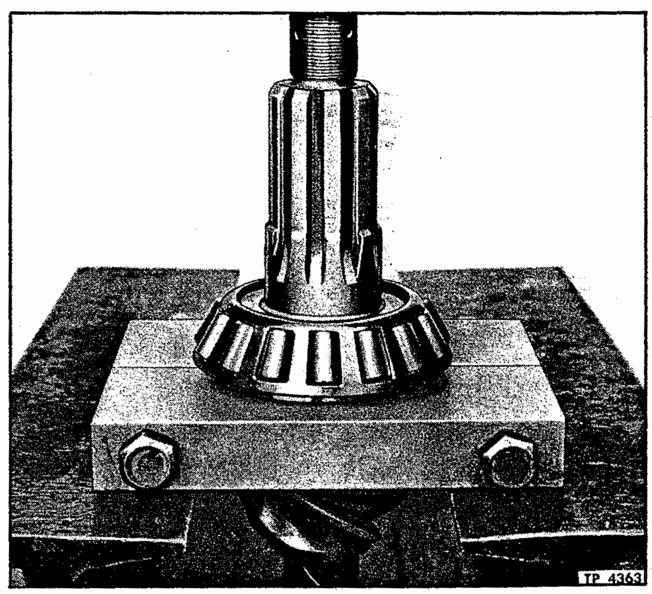


Figure 5—Pinion Bearing Removal

REAR AXLE

spection Operations" later in this section. If bearings pass inspection, dip bearings in differential lubricant, recommended in LUBRICATION (SEC. 13), then wrap bearings in clean cloth or paper until ready to reassemble axle.

CLEANING PARTS

Immerse all parts in suitable cleaning fluid and clean parts thoroughly. Use a stiff bristle brush to remove all old lubricant. Remove particles of gaskets which may adhere to mating faces of axle housing, differential carrier, hubs, and axle shaft flanges. Clean out lubricant channels in pinion cage and differential carrier. Clean housing breather. Make certain that interior of axle housing is thoroughly cleaned.

INSPECTION

Whenever available, the Magna Flux method should be used on all steel parts, except ball and roller bearings. This method is especially suited for inspection of ground or highly finished surfaces for wear and cracks which otherwise would not be visible to the naked eye.

INSPECTION OPERATIONS

1. Bearings. Rotate each bearing slowly, and at the same time examine bearing for roughness, damage, defects, or wear. Note condition of bearing cage. Replace bearing if cage is damaged or if any of the conditions previously noted exist.
2. Gears. Examine drive gear, drive pinion, and differential gears for damaged teeth, worn spots in surface hardening, and distortion. Examine bushings in differential pinions for grooves, or excessive wear, and check fit of gears on spider. Refer to "Specifications" at end of this section for limits. Check radial clearances between differential side gear hubs and differential case.
3. Differential Case. Inspect differential case assembly for cracks, distortion, or damage. If case is in good condition, thoroughly clean case and cover; then assemble case with bolts and mount in lathe centers or "V" block stand. If lathe is NOT available, install differential side bearings and mount case in differential carrier as directed under "Differential Assembly Installation" later in this section. Install dial indicator and check differential case run-out. Refer to "Specifications" at end of this section, for run-out limits. Whenever run-out exceeds limits, differential case run-out may be corrected as later described under "Repair" in this section.
4. Axle Shaft Splines. Examine splined end of axle shaft for twisted or cracked splines, twisted shaft, or damaged flange. If any of above conditions are evident, install new axle shafts.
5. Axle Shaft and Flange Run-Out. Install axle shaft assembly in lathe centers or "V" blocks. Check shaft run-out with dial indicator; if run-out exceeds limits listed in "Specifications" at end of this section, discard axle shaft. Position dial indicator so that indicator shaft end contacts inner surface of flange near outer edge, than check flange run-out. If run-out exceeds limits listed in "Specifications" at end of this section, discard axle shaft.

HOUSING INSPECTION

If check made prior to disassembly of axle indicated a bent condition at axle housing, make more complete check of housing on surface plate and after locating point at which housing is bent, the housing may be straightened if equipment is available. Any straightening must be done with axle housing COLD DO NOT APPLY HEAT TO HOUSING.

OIL SEAL INSPECTION

Replacement of oil seal when unit is disassembled is more economical than premature overhaul to replace this part at a future time. Further, loss of lubricant through a worn seal may result in failure of other parts, such as gears and bearings.

Handle seal carefully, particularly when being installed. Cutting, scratching or curling under of lip of seal seriously impairs efficiency of seal. Use of Permatex or equivalent around outer diameter of seal is recommended to insure against leakage at that point.

OIL SEAL SLEEVE

Carefully inspect oil seal sleeve at propeller shaft flange for any pitted, corroded, or worn condition at oil seal contact surface. If such imperfections cannot be cleaned up by polishing, the sleeve must be replaced.

REPAIR

Differential Case. Excessive run-out on differential case may be corrected by machining flange on gear side of case. Remove sufficient metal from flange to correct excessive run-out. Metal must be cut on a true plane removing just enough metal to bring run-out within limits listed in "Specifications" at end of this section. After differential case has been machined, remove burrs and clean case assembly thoroughly.

Propeller Shaft Flange Sleeve. Whenever inspection indicates that oil seal contact surface of sleeve on propeller shaft flange is corroded or pitted, the condition may be corrected by cleaning and polishing surface with a suitable abrasive cloth. If cleaning and polishing surface of sleeve does not clear up the condition, remove sleeve and install new part.

SPIDER PINION BUSHING REPLACEMENT

Spider pinion is fitted with a bushing, which can be replaced; thereby eliminating need of replacing gear when excessive clearance exists at spider arm.

Removal

1. Place gear is vise fitted with soft jaw pads.
2. Use hack saw to split bushing at two places approximately opposite each other. Two halves of bushing can now be easily removed.
3. Remove burrs or sharp edges from pinion bore which might interfere with proper bushing installation.

Installation

A bushing replacing and burnishing kit is available for installing and burnishing bushing to correct size.

1. Place pinion gear on tubular anvil, then position bushing in inner end of pinion bore.
2. Select proper size adapter, then press bushing in pinion.
3. Select burnishing ball that is approximately 0.005" larger than spider arm diameter.
4. Press burnishing ball through bushing, using round bar against ball. This burnishing ball will force bushing metal into groove inside pinion bore, thereby securely locking bushing in pinion. Inside diameter of bushing is sized to provide correct clearance between bushing and spider arm.

ASSEMBLY

After all parts have been thoroughly cleaned, apply a thin coating of differential lubricant, as specified in LUBRICATION (SEC. 13), on all thrust or bearing surfaces. Coating parts will prevent scoring when vehicle is first placed in service.

Use of new lock washers, gaskets, and oil seals is recommended during assembly of axle.

All adjustments, given in assembly procedures must be made carefully to insure efficient and continuous axle operation. KEY NUMBERS IN TEXT REFER TO FIGURE 1, UNLESS OTHERWISE INDICATED.

DRIVE PINION AND CAGE ASSEMBLY

1. If pinion bearing cups (29 and 31) were removed during disassembly, press bearing cups firmly against shoulder of pinion bearing cage.
2. Position pinion bearing (32) on drive pinion (33), with widest part of bearing cone toward gear teeth, then press bearing on pinion until bearing cone is seated solidly on drive pinion.
3. Position drive pinion inner bearing (34) on drive pinion (33), using arbor press to force bearing into place. Install retainer ring (35) to retain bearing.
4. Install pinion bearing spacer (30) on drive pinion, then lubricate pinion bearing cones and cups with light engine oil.
5. Insert drive pinion (33) and bearing assembly into pinion cage (27); then, using an arbor press, press outer pinion bearing (28) firmly against bearing spacer (30). Rotate bearing cage through several complete revolutions to assure normal bearing contact.
6. While assembly is still in press under pressure (14 ton), check drive pinion bearing pre-load. Wrap soft wire around pinion bearing cage (27) as shown in figure 6. Attach pound scale to wire, then pull on scale, keeping scale in a horizontal plane. Note scale reading when assembly is rotating freely. To compute inch-pound value of scale reading, multiply scale reading (pounds) by one-half pinion cage diameter (inches). If reading does not fall between limits given in "Specifications" at end of this section, use thinner spacer (30) to increase or thicker spacer to decrease pinion bearing pre-load. Spacer thicknesses available are given in "Specifications" at end of this section.

NOTE: If arbor press is not available, temporarily install propeller shaft flange (25), washer (23), and (24). Tighten nut to 800-1100 foot pounds torque, then check pinion bearing pre-load as directed in preceding paragraph. Remove nut, washer, and flange after adjustment.

7. After bearing pre-load adjustment is completed, lubricate oil seal assembly (26) and cover outer edge of seal body with a non-hardening sealing compound; then install oil seal spacer (21) in pinion cage (27) using a suitable driver.
8. Clean splines on drive pinion and propeller shaft flange, then install flange on drive

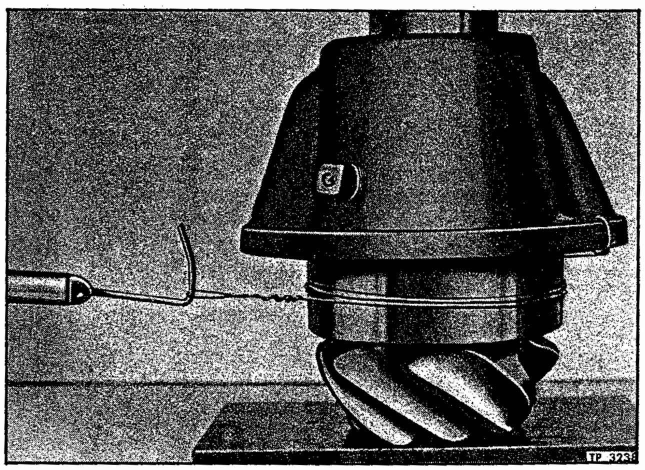


Figure 6—Checking Pinion Bearing Pre-Load

pinion. Place washer (23) on drive pinion (33), then install nut (24). Tighten nut to minimum torque of 800 foot pounds, then tighten nut until next castellation on nut lines up with cotter pin hole in drive pinion and install cotter pin.

DRIVE PINION INSTALLATION

1. Lubricate drive pinion bearings with rear axle lubricant recommended in LUBRICATION (SEC. 13).

2. Place original pinion cage shims (17) over pinion cage studs (20), then position drive pinion and cage assembly on studs (20). IMPORTANT: Oil holes in shims must line up with oil passages in differential carrier and cage when installed, to assure proper lubrication of drive pinion bearings (28 and 32).

3. Install new lock washers (18) and nuts (19) on studs (20). Tighten nuts (19) to recommended torque.

DIFFERENTIAL ASSEMBLY

After checking differential case run-out as previously described under "Cleaning, Inspection, and Repair" in this section, assemble differential as follows:

1. Lubricate differential case inner walls and all component parts of differential assembly with rear axle lubricant specified in LUBRICATION (SEC. 13).

2. Position side gear thrust washer (13) on hub of side gear (12), then place gear in flanged half of differential case (2).

3. Lay flanged half of case on bench with flange upward, place differential pinions (43) and pinion thrust washers (4) on differential spider (3), place pinion and spider assembly on side gear (12) previously installed, then install remaining side gear

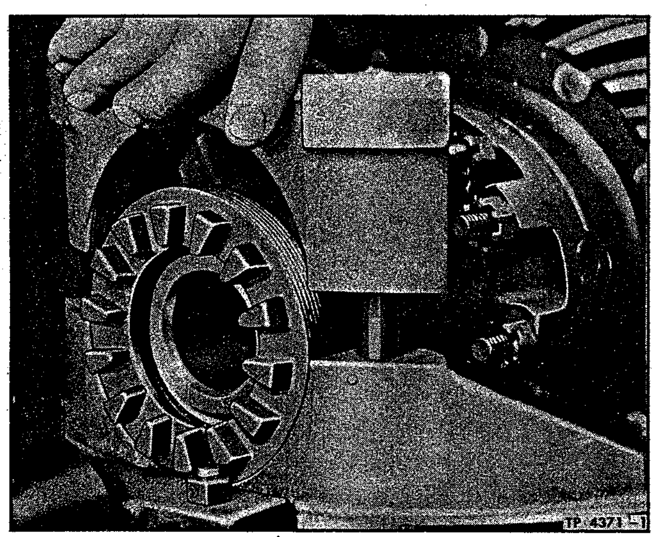


Figure 7—Side Bearing Cap Installation

(12) and thrust washer (13).

4. Place plain half of differential case on opposite half with alignment marks positioned as shown in figure 3, then insert case bolts (45), downward through both halves.

5. Install nuts (5) on four equally spaced bolts (45), tighten to recommended torque. Check assembly for free rotation. If rotation is free and smooth, install remaining nuts (5) and tighten to recommended torque. Again check for free rotation. Install lock wire through all bolts.

6. Position drive gear (1) on differential case (2), with alignment stars stamped on plain case and drive gear in alignment. Install and tighten bolts (15), evenly and alternately to recommended torque. Then install lock wire (14) through bolt heads in such a manner that lock wire will become tighter if bolts loosen.

7. Press differential side bearings (40) on hubs of differential case (2) until bearing cones are seated firmly.

DIFFERENTIAL ASSEMBLY INSTALLATION

Proper bearing cup and adjusting ring fit is of utmost importance and should be carefully checked before differential is installed.

1. Temporarily install bearing cup (41), adjuster ring (8), and bearing cap (42), then tighten stud nuts to recommended torque.

2. Bearing cup must be a hand push fit in bore, otherwise the bore must be reworked with a scraper or emery cloth, until proper fit is obtained. Location of high spots in carrier bore can be readily located by applying a light coating of prussian blue to bearing cup.

3. If adjusting ring cannot be turned by hand or with a maximum of 20 lbs. ft. torque, this indicates that ring may be oversize and another ring that provides proper fit should be used.

4. Coat differential side bearing cones and cups with rear axle lubricant specified in LUBRICATION (SEC. 13).

5. Place bearing cups (41) over bearing cones (40), then position differential assembly in differential carrier.

6. Insert bearing adjusting rings (8) and turn hand tight against bearing cups (41).

7. Place differential bearing caps (42) over studs with alignment marks in line (fig. 7), then tap lightly into position.

CAUTION: If bearing caps do not seat easily and properly, adjusting rings may be cross-threaded. Remove bearing caps and reposition adjusting rings. Forcing caps into position will result in irreparable damage to differential carrier or to bearing caps.

8. Install nuts on bearing cap studs, tighten nuts to recommended torque.

9. Tighten adjusting rings (8), alternately until

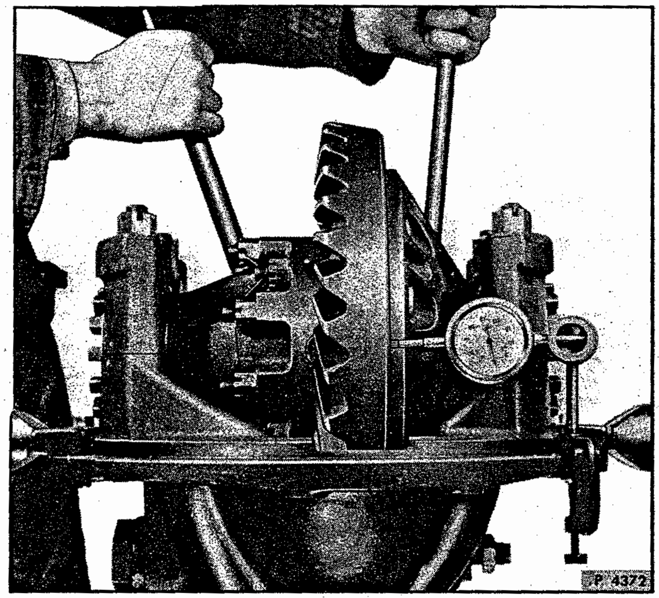


Figure 8—Differential Bearing Pre-Load Adjustment

tight. Revolve differential assembly after each tightening to assure normal bearing contact and to keep bearing cups straight in bores.

DIFFERENTIAL BEARING PRELOAD ADJUSTMENT

1. Using dial indicator at back face of drive gear (1) as shown in figure 8, loosen bearing adjusting ring (8), on flanged side, enough to notice end play on dial indicator.

2. Tighten the same adjusting ring until 0.000" end play is obtained.

3. Tighten adjusting rings (8) one notch each from 0.000" end play position to impose correct preload on differential side bearings.

NOTE: After adjusting bearing pre-load, proceed with tooth contact and backlash adjustment as directed in following paragraph.

GEAR TOOTH CONTACT ADJUSTMENT

Drive pinion (33) is adjusted for tooth contact by means of shims (17) between pinion cage (27) and differential carrier (16). Drive gear (1) is adjusted by means of adjusting rings (8).

If original gears are reinstalled in assembly, painting gear teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for extensive periods, form running contacts due to wear on teeth. Therefore, the original shim pack (17) plus one .005" shim should be maintained to check backlash. Figure 9 shows typical method of checking backlash.

In the event that backlash exceeds maximum tolerances, reduce backlash only in the amount that will avoid overlap of worn teeth (fig. 10).

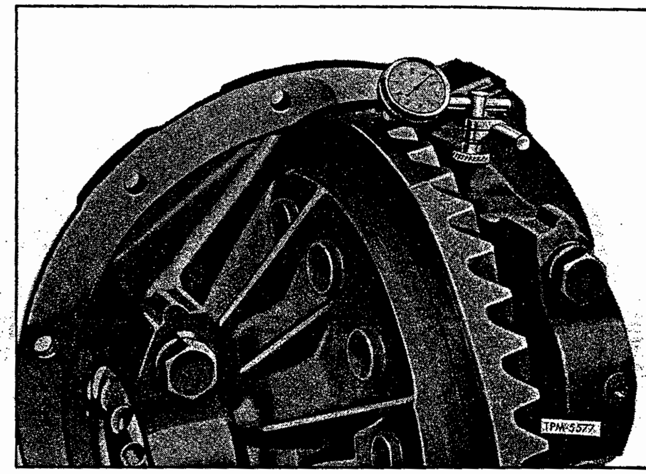


Figure 9—Back Lash Check (Typical)

When new gears are to be installed, differential bearings and drive pinion bearings must be in proper adjustment before any attempt is made to adjust backlash. Check backlash with dial indicator as shown in figure 9, and adjust to obtain 0.006" - 0.012" lash. Adjust backlash and tooth contact in the following manner:

1. Paint at least ten teeth of bevel gear with a mixture of red lead or prussian blue and engine oil. Rotate gears through a few revolutions in both directions by hand. Refer to gear tooth contact charts (fig. 11), for directions when making proper adjustments.

2. When satisfactory tooth contact and backlash has been obtained, recheck bearing cap stud nuts to be sure they are tightened to recommended torque, then secure nut with cotter pin. Install adjusting ring locks (6) and secure bolts (7) with lock wire.

DIFFERENTIAL CARRIER INSTALLATION

1. Clean flanges of differential carrier (16) and axle housing (10), then position new differential carrier gasket (11) on carrier studs (36).

2. Roll differential carrier assembly into position using roller jack. Start carrier into housing using four flat washers (38) and nuts (37) equally spaced, then tighten nuts alternately and evenly

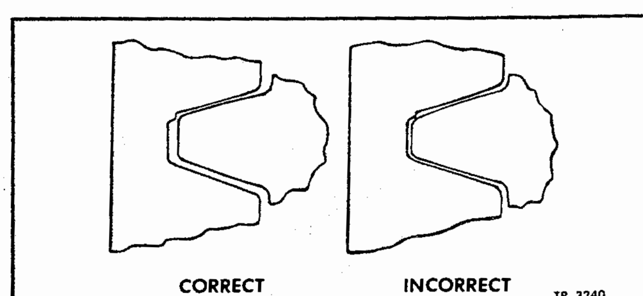
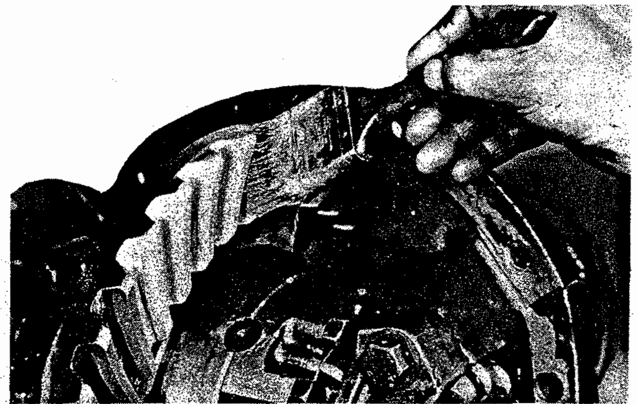
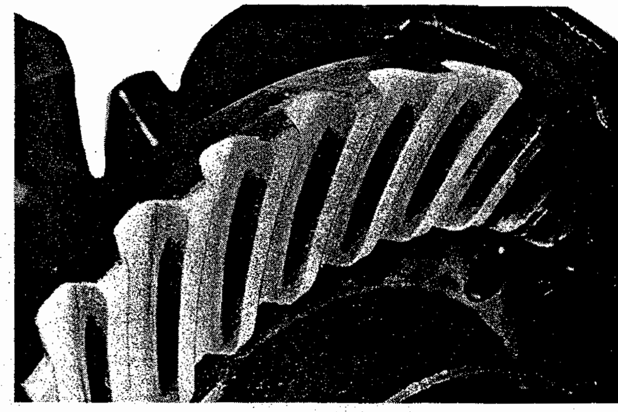


Figure 10—Tooth Cross Section

REAR AXLE

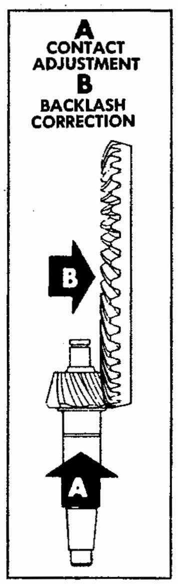


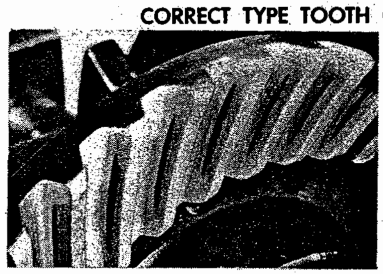
PAINTING GEAR TEETH



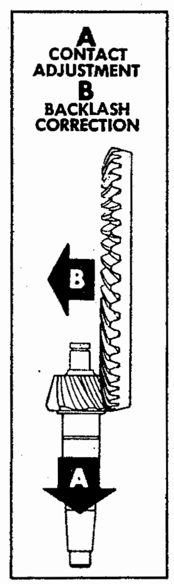
CORRECT TYPE TOOTH CONTACT

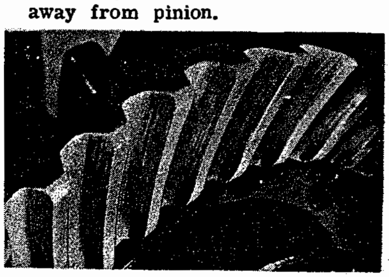
A HIGH NARROW CONTACT is not desirable. If gears are permitted to operate with an adjustment of this kind, noise, galling and rolling over of top edge of teeth will result. To obtain correct contact, move pinion toward bevel gear. This lowers contact area to proper location. This adjustment will decrease the backlash which may be corrected by moving bevel gear away from pinion.



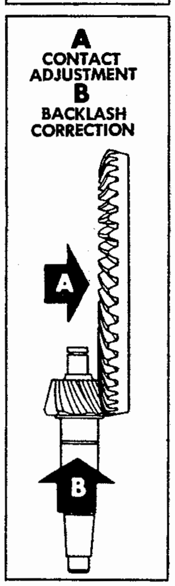


A LOW NARROW CONTACT is not desirable. If gears are permitted to operate with an adjustment of this type, galling, noise and grooving of teeth will result. To obtain correct contact, move pinion away from drive gear. This will raise contact area to proper location. A correct backlash is obtained by moving bevel gear toward pinion.





A SHORT TOE CONTACT is not desirable. If gears are permitted to operate with an adjustment of this type, chipping at tooth edges and excessive wear due to small contact area will result. To obtain correct contact, move drive gear from pinion. This will increase the lengthwise contact and move contact toward heel of tooth. Correct backlash is obtained by moving pinion toward bevel gear.



A SHORT HEEL CONTACT is not desirable. If gears are permitted to operate with an adjustment of this type, chipping, excessive wear and noise will result. To obtain correct contact, move drive gear toward pinion to increase lengthwise contact and move contact toward toe. A correct backlash is obtained by moving pinion away from drive gear.

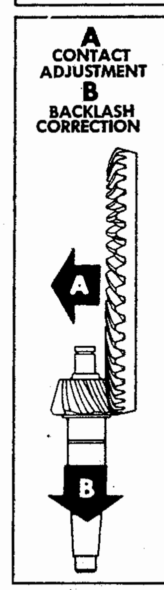


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Figure 11—Tooth Contact Chart

to draw carrier squarely into housing. CAUTION: Driving carrier into axle housing by use of a steel hammer will not only damage carrier stud flange but will also cause oil leaks.

3. Remove nuts and flat washers, then install lock washers and stud nuts. Tighten nuts to recommended torque.

4. If housing has not been removed from vehicle, connect propeller shaft to propeller shaft flange (25) as instructed in PROPELLER SHAFT (SEC. 18).

5. Install drain plug and tighten firmly. Fill axle housing to proper level with lubricant specified in LUBRICATION (SEC. 13). Install and tighten filler plug.

COMPLETING ASSEMBLY

1. Before installing axle shafts hubs should be removed, and bearings cleaned, inspected, and adjusted as directed in HUBS, WHEELS, AND TIRES (SEC. 19).

2. Install axle shafts as directed previously under "Axle Shaft Replacement" in this section.

3. Complete instructions for installation of rear axle assembly will be found in "AIR SUSPENSION" (SEC. 14) of this manual.

Reference Should Be Made To LUBRICATION (SEC. 13) For Proper Grade And Type Of Axle Lubricant.

REAR AXLE

SPECIFICATIONS

TYPE	Angle Spiral Bevel
DRIVE	Radius Rods
RATIO	
Standard	4.125:1
Optional	3.56:1
ADJUSTMENTS & CLEARANCES	
Drive Gear & Pinion Backlash	0.006" - 0.012"
Adjustment Method	See Text
Shim Thickness (Carrier to Cage)	0.005" - 0.010" - 0.020"
Pinion Bearings	
Adjustment Method	Selective Spacers
Spacer Thickness	0.187" - 0.188" - 0.190" 0.192" - 0.194" - 0.196" - 0.198" 0.200" - 0.201" - 0.215" - 0.229"
Rotating Torque (In. Lbs.)	5 to 15
Differential Bearings	
Adjustment Method	Threaded Adjusting Rings
Bearing Pre-Load	See Text
DIFFERENTIAL CASE	
Run-Out (Max.)	0.002"
Diameter at Side Gear	3.064" - 3.066"
SIDE GEAR	
Diameter at Differential Case	3.053" - 3.057"
Radial Clearance - Gear to Case	0.007" - 0.013"
SPIDER PINION	
Bushing I.D. (Burnish)	1.251" - 1.253"
Clearance - Bushing to Spider	0.003" - 0.007"
SPIDER	
Diameter of Arms	1.246" - 1.248"
Arms in Same Plane Within	0.0025"
Arms On Center Within	0.003"
THRUST WASHER THICKNESS	
Side Gear	0.121" - 0.125"
Spider Pinion	0.058" - 0.062"
AXLE SHAFT	
Type	Full Floating
Drive Flange Run-Out (Max.)	0.005"
Shaft Run-Out at Center	1/16"
Diameter at Splined End	2.372"-2.377"
TORQUE SPECIFICATIONS (Ft. Lbs.)	
Propeller Shaft Flange Nut	800-1100
Pinion Cage Stud Nuts	80-105
Carrier to Housing Stud Nuts	160-205
Differential Case Bolt Nuts	180-235
Differential Bearing Cap Stud Nuts	360-465
Bevel Gear Cap Screw	80-105
Adjusting Ring Lock Cap Screw	15-20
Axle Shaft Flange Stud Nut	75-100

Body

This group is divided into three sections covering "GENERAL BODY MAINTENANCE," "HEATING AND VENTILATION," and "LAVATORY."

General Body Maintenance

The body comprises the main structure of the vehicle. Unlike conventional motor cars and trucks, separate frame is not used. All units such as power plant, running gear, steering system, etc., are attached directly to body.

Since separate frame is not used, all road shock, driving and braking stresses, etc., are absorbed in body framing and outer panels. A small amount of twist occurs in body, as complete rigidity of the structure is not desirable. It is, therefore, important that body be regularly inspected for loose rivets and bolts.

Entire vehicle should be regularly inspected for condition of paint and for corrosion damage, with particular attention given to underside. Inspection should be made more frequently in freezing weather due to the corrosive effect of road de-icing materials (salt, calcium chloride, etc.) on metal. If inspection discloses any evidences of corrosion, paint failure, or bare metal, corrective measures as outlined under "Painting" (later in this section) should be immediately employed.

EXTERIOR MAINTENANCE

Body painted surfaces and polished side mouldings should be protected by a coating of wax, applied at regular intervals. Periods between applications should be sufficiently short to assure continuous protection of the finish. Any good body wax can be used for both painted and polished surfaces. Wax should be applied immediately after coach has been cleaned.

When necessary to remove previous wax coating, gasoline or similar solvents meeting local fire and health regulations may be employed.

Hard, anodized finish on side mouldings is produced by an electrochemical process. Anodic coating is abrasion-resistant and may be cleaned, if necessary, with a mild abrasive cleaner. However, this finish, like other aluminum, is attacked by many acids and most alkalies. Consequently, considerable care should be taken in the selection of chemical cleaners. Do not use an alkaline cleaner.

PAINTING

Aluminum corrodes just as iron and steel rusts. Under certain conditions aluminum will corrode more rapidly than steel. Inspect body surfaces regularly for corrosion and paint condition.

REPAINTING ALUMINUM PARTS

1. Thorough cleaning is essential. All corrosion, grease and other foreign matter must be removed. Solvent cleaning, pressure steam cleaning, wire brushing, and hand sanding methods are recommended.

2. Completely remove old paint by use of organic solvents. Do not use alkaline paint remover on aluminum. If old primer is very difficult to remove and there is no evidence of metal corrosion, old primer may be left on, but all loose paint must be removed.

3. Apply a coat of pre-primer (sometimes called wash-primer), preferably by spraying to a uniform and complete coverage coat on all surfaces. This type primer uses a special accelerating agent containing phosphoric acid which produces an excellent bond to metal. AP-10 made by United Chromium, Inc. and XE-5220 made by Bakelite Corporation, or any equivalent material made by a reputable paint manufacturer should be acceptable. These materials must be used within a few hours after addition of accelerator, therefore, directions of manufacturer should be observed carefully. In lieu of a pre-primer, apply warm 5% sodium dichromate or potassium dichromate solution (two ounces dichromate in one quart of water) to cleaned surfaces. Apply by spraying. Allow parts to dry.

4. Use a zinc chromate primer such as DuPont 63-1016 or Arco 214-30089, or any equivalent material made by a reputable manufacturer.

Apply primer, preferably by spraying, in a very thin coat. If zinc chromate primer cannot be obtained, use of a red oxide primer is recommended, but only as an emergency measure.

5. Apply finish coats:

a. For understructure and other parts not requiring color, apply two coats of the following, or equivalent: Reduce five parts of DuPont RC-147

clear Dulux with one part Duco #3637 Thinner. To each gallon add two pounds Albron (aluminum) paste, stirring mixture thoroughly.

b. If synthetic aluminum enamel is not available, any synthetic or other enamel, aluminum lacquer, or other lacquer, in that order, may be used; but only materials made by a reputable manufacturer should be employed. Then apply one heavy coat of asphalt-base sheet metal deadener approximately 1/32" thick. Special spray equipment, including pressure tank, must be used if deadener is applied by spraying.

c. To exposed body parts, apply air-drying surfacer and color coats in accordance with standard practice.

REPAINTING STEEL PARTS

The foregoing procedures may also be applied to steel and iron parts, with following exceptions:

1. Apply a coat of pre-primer (sometimes called wash-primer), preferably by spraying to a uniform and complete coverage coat on all surfaces. This type primer uses a special accelerating agent containing phosphoric acid which produces an excellent bond to metal. AP-10 made by United Chromium, Inc., and XE-5220 made by Bakelite Corporation, or any equivalent material made by a reputable paint manufacturer should be acceptable. These materials must be used within a few hours after addition of accelerator therefore, directions of manufacturer should be observed carefully. Use of phosphoric-base metal conditioner, such as "Metalprep" (Neilson Chemical Co.) or "Deoxidine" (American Chemical Paint Co.) is also recommended in preparing steel for painting. These materials vary in method of application and use, and should be employed only as directed by the manufacturer.

2. Both organic and alkaline paint removers may be used on steel parts. However, if alkaline removers are used, all traces of alkali must be washed off before primer is applied.

3. Oxide-type primer is recommended for use on steel parts, instead of zinc chromate primer.

PAINTING NEW ALUMINUM PARTS

When installing new aluminum parts, or new parts which contact with aluminum parts in assembly, succeeding procedures should be followed:

1. Remove old parts to be replaced.

2. Treat all exposed sides of adjacent parts remaining in body according to previous instructions in steps 1, 2, 3, and 4 under "Repainting Aluminum Parts: if aluminum; if steel, treat as in steps 1, 2, and 3 under "Repainting Steel Parts." Apply finish coat per step 5a under "Repainting Aluminum Parts" to all surfaces both steel and aluminum.

3. Prime coat all sides of new parts to be installed as outlined in step 4 of "Repainting Aluminum Parts," and step 3 of "Repainting Steel Parts"; then apply finish coat as in step 5a. under "Repainting Aluminum Parts" to all surfaces both steel and aluminum.

4. Use only zinc or cadmium coated bolts, washers, and nuts. Dip all bolts, nuts, washers, and rivets in primer and allow to dry.

5. Install new parts, then apply finish coats as outlined in step 5 of "Repainting Aluminum Parts."

PAINTING NEW STEEL PARTS

The above procedures may be applied to new steel and iron parts except that oxide base primers are recommended in place of zinc chromate type.

REPAIR AND REPLACEMENT

GENERAL

Body and underframe can be repaired and replaced by competent craftsmen with proper tools and equipment.

In the event of serious collision damage, the Coach Technical Service Department of GMC Truck and Coach Division will furnish data, sketches, and other information upon request. Reply will be expedited by specific description of damage, and particularly if photographs are furnished.

REPLACING BODY PARTS

Whenever repairing or replacing aluminum parts, carefully follow accepted and recommended practices. The Aluminum Company of America will furnish, upon request, booklets titled "Riveting Alcoa Aluminum" and "Welding and Brazing Alcoa Aluminum." The booklets explain detailed procedures necessary in repair and replacement of aluminum parts.

Proper precautions must be observed, particularly with reference to welding, reinforcing, corrosion prevention, and replacement, as follows:

1. Welding of aluminum structural members, or any aluminum parts subject to strain or compression, is not recommended. To maintain proper body strength, replace damaged posts, and other structural members with new parts obtained from the factory.

2. To prevent galvanic corrosion of aluminum, all surfaces of dissimilar metals in contact with aluminum must be properly coated with paint and or plating. This also applies to attaching parts such as bolts, washers, nuts, and rivets. Refer to "Repainting Aluminum Parts" and "Painting New Aluminum Parts," earlier in this section.

CAUTION: Avoid mixing steel and aluminum structures or parts when making repairs. Do not substitute steel for aluminum in coach structure.

Steel can be used for support fittings for separate units, such as air tanks, control rods, etc. Greater deflection of aluminum causes steel parts to tend to take entire load when used in combination with aluminum parts.

STRAIGHTENING

Use of heat when straightening structural parts of body is not recommended, since heat affects structural characteristics of certain alloys and especially heat-treated parts. All body structural members should be straightened cold; any part bent or buckled sufficiently to show strains or cracks after straightening should be replaced, or properly reinforced.

CUTTING

When cutting a structural member, cut at an angle of 30 degrees. Thus, actual length of cut is twice width of piece being cut, and stress or load is distributed over a longer joint when welded. Cutting can be done by torch, although use of saw is preferred, since cut is cleaner and less material is removed.

REINFORCING

CAUTION: Before reinforcing any part of vehicle, determine cause of failure. Body and frame are integral; therefore, driving stresses and strains are transmitted throughout body. Reinforcing a point of apparent failure without correcting underlying cause of failure, may transfer stress to other parts not engineered for such stress, with resultant development of new failures. Since body is designed to "weave." a rigid reinforcement in any part of body may nullify the design of entire vehicle.

Reinforcements can be made of flat, angle or channel stock, whichever is most suitable for purpose. Use of angle reinforcements is recommended due to difficulty in fitting channel reinforcements. Reinforcements should be sufficiently long to distribute load evenly over a considerable area and thickness should not exceed that of member being reinforced. Reinforcements should be riveted to broken parts.

RIVETING

Cold aluminum rivets should be used in aluminum parts.

Diameter of rivets should be approximately 100% thickness of plates to be riveted, although rivet diameter is also dependent upon spacing and number used.

Replacement of body parts will necessitate removal of rivets in many cases. Rivets can be removed readily by cutting off rivet head with a sharp chisel, marking center of rivet with a center punch, then drilling out rivet with a drill slightly smaller than body of rivet. Rivet can also be driven out with punch, instead of being drilled out, depending upon type and size of material riveted. If rivet is large, first cut a groove across center of rivet head with a cape chisel before cutting off head with a flat chisel.

WELDING

Refer to note, earlier in this section, regarding welding of structural parts.

Inert arc welding is recommended as heat of weld is localized and burning of material minimized with this method. When welding a cut member, fill or weld cut completely. Welding rods should be of substantially same material as parts to be welded.

SEALING

When replacing front, side, rear panels, and particularly roof panels, special attention should be given to sealing of joints with sealing and caulking compounds.

ENTRANCE DOOR AND CONTROLS

Entrance door is sedan type, hinged at front, and opens outward. Door is hand-operated type, controlled by door operating mechanism connected between dash and door. Mechanism is so designed that door is locked firmly in either fully open, or fully closed position. Door, however, can be opened from outside vehicle by pushing in on door release rod knob (1, fig. 1) located in front panel below windshield.

ADJUSTMENT

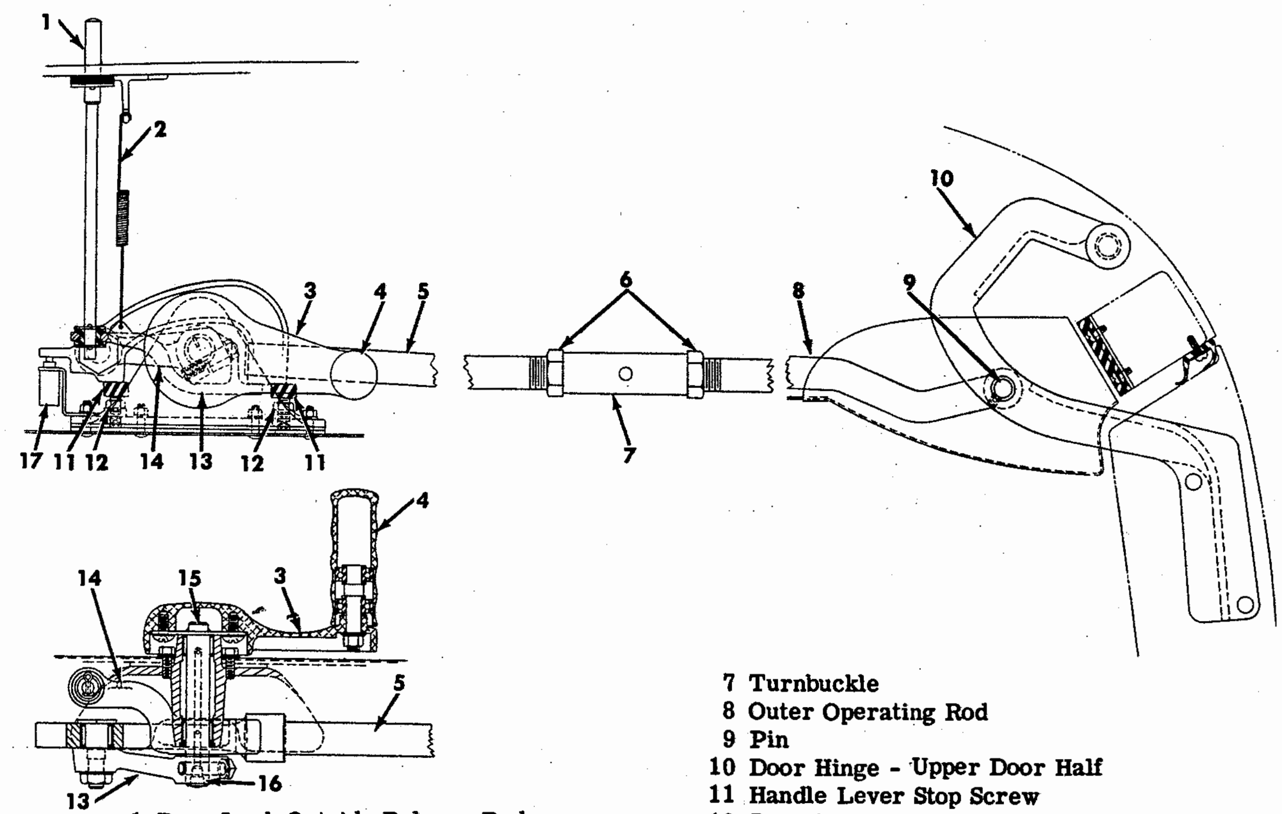
NOTE: Key numbers in text refer to figure 1.

Mechanism is adjusted by loosening two jam nuts (6), which lock turnbuckle (7) connecting door operating rods (5 and 8); then turning turnbuckle to shorten or lengthen rods. Turnbuckle is accessible under dash after entering safety compartment at right side of dash. Tighten turnbuckle jam nuts (6) after desired adjustment of rods is obtained.

Two stop screws (11), which are adjustable, are located on each side of control handle lever (13) under dash panel. Adjustment of stop screws regulate the over-center position of door operating rod control handle lever (13). Properly adjusted mechanism will swing over-center and lock door firmly in both fully open and closed position. In either position, it should not be possible to move door unless operating handle (3) is first moved out of locking position. After adjusting stop screws (11); tighten stop screw jam nuts (12).

EXTERIOR COMPARTMENT DOORS

All exterior compartment doors are rubber hinged at top except engine compartment, transmission, and tool compartment doors.



1 Door Lock Outside Release Rod
2 Release Rod Return Spring
3 Door Operating Handle
4 Operating Handle Knob
5 Inner Operating Rod
6 Jam Nut
7 Turnbuckle
8 Outer Operating Rod
9 Pin
10 Door Hinge - Upper Door Half
11 Handle Lever Stop Screw
12 Jam Nut
13 Control Handle Lever
14 Outside Lock Release Rod Lever
15 Operating Handle Shaft
16 Lubrication Plug
17 Stepwell Light Switch

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Figure 1—Entrance Door Control Mechanism

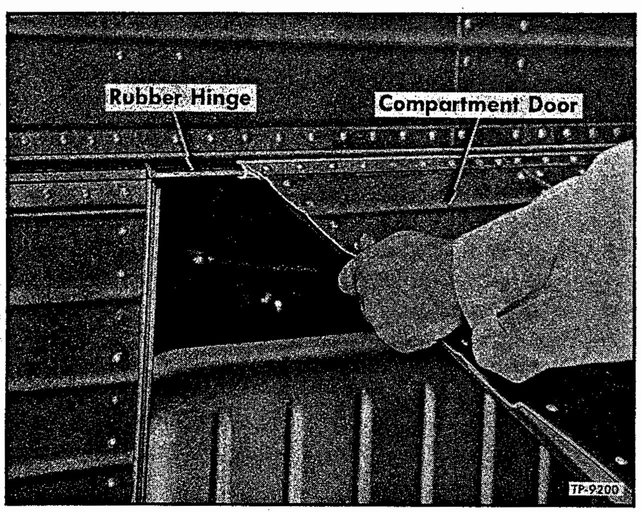


Figure 2—Replacement of Rubber Hinged Compartment Doors

Rubber-hinged compartment doors are of the lift-type. Doors lift outward and up, and are supported in open position by either a telescopic support prop or a straight support rod.

In order to lower compartment doors equipped with telescopic type support prop, it is first necessary to raise door slightly to trip catch on support prop before lowering door.

REPLACEMENT OF RUBBER HINGED DOORS

Removal (Fig. 2)

1. Open door to full open position; then remove screws which secure door hinge channel to hinge.
2. Lower door to a position until door is at an approximate 90 degree angle to side of coach. With the aid of an assistant, slide door from hinge.

Installation (Fig. 2)

1. Apply glycerin, talcum powder or a soap solution to hinge to facilitate door installation. IMPORTANT: Do not use oil or grease on hinge.

2. With aid of an assistant at one end of door, align door hinge channel with hinge and slide door onto hinge. Secure door to hinge with screws.

BAGGAGE, AIR CONDITIONING ENGINE, AND ELECTRICAL COMPARTMENT DOORS

Baggage, air conditioning, and electrical compartment doors, incorporate flush type latch locks as shown in figure 3. Lock operating latch is flush mounted at center rub rail portion of each door. Insert fingers under operating latch; then pull outward and up to unlatch door. To close door, hold door in closed position with operating latch in open or outward position; then release and push down on latch to secure door.

CAUTION: Do not drop door to closed position as damage to door or body may result.

This particular type latch can be adjusted to regulate door-to-body seal tightness. Make adjustment if necessary in the following manner:

1. Loosen two lock nuts (fig. 3) securing turnbuckle on release latch control link.

2. Turn link turnbuckle to obtain desired adjustment of door-to-body seal tightness, then retighten turnbuckle lock nuts.

ENGINE COMPARTMENT DOOR

Engine compartment door, which is hinged at top is opened by pulling lock release handle located inside of door, to the left. Release handle is accessible through license plate holder opening. Door is retained in closed position by two locking rods which engage catches on engine rear hanger tubes. Catches can be repositioned on tubes permitting adjustment of door-to-body fit. Door is held in open position with two telescopic support props. In order to lower door it is first necessary to raise door slightly which will trip catches in support props and permit door to be lowered. CAUTION: Do not drop door to closed position as damage to locking rods or catches may result.

TOOL COMPARTMENT DOOR

Tool compartment door located at left front corner of coach is hinge mounted at front and swings outward. To open door pull latch handle, which extends below left bumperette, rearward: then swing door open. Door is retained in closed position by two locking rods which engage body catches at top and bottom of door. Body catches can be repositioned to permit adjustment of door-to-body tightness by loosing catch attaching cap screws; adjusting door-to-body tightness; then retightening cap screws.

TRANSMISSION COMPARTMENT DOOR

Transmission compartment door located at right rear corner of coach is hinged mounted at front and swings outward. Door is equipped with latch at lower rear edge and is retained in closed position by locking rod which engages body catch at top and bottom of door. Body catch and door stop bracket can be repositioned to permit adjustment of door-to-body fit by loosening attaching cap screws, adjusting door, and then retightening cap screws.

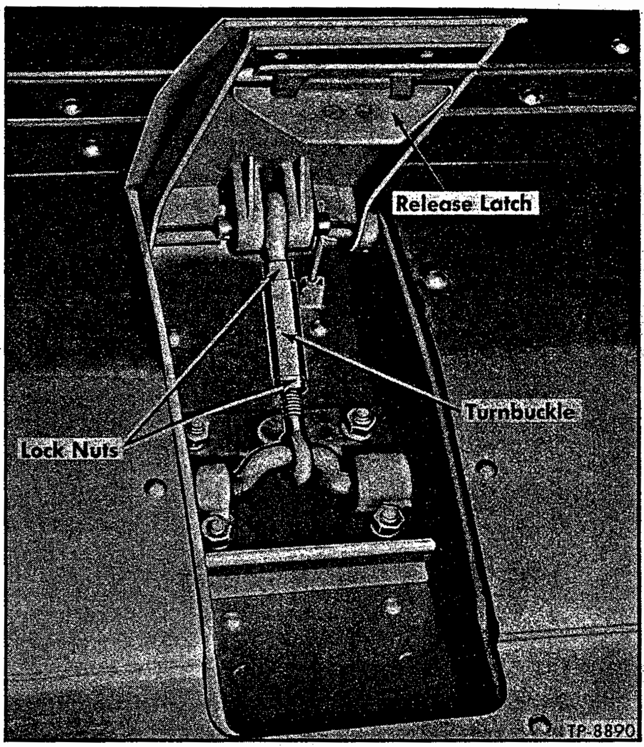


Figure 3—Compartment Door Release Latch

BATTERY COMPARTMENT DOOR

Battery compartment door is retained in closed position with two spring-loaded pull-type latch handles located under door. To open, pull both latch handles outward to release door. To retain door in closed position, pull both latch handles outward, press in on bottom of door and engage handles in door catches.

AIR CONDITIONING RADIATOR DOOR

Air conditioning radiator door is retained in closed position with two spring-loaded latch handles located under door. To open door, push down on latch handles which force out latch springs engaging door catches; then push down on latch springs and pull out on door.

To close door, hold door in closed position and lift up on latch springs engaging door catches; then pull down and outward on latch handles.

Door-to-body tightness can be adjusted by repositioning each latch assembly. Screw holes in latch are elongated to permit adjustment.

SPARE TIRE COMPARTMENT DOOR

Spare tire compartment door at front center of coach in back of front bumper also serves as a mounting for the front bumper. Door is hinged at bottom and attached to body framing at top of door with two special lug bolts. To open door, insert wheel lug wrench through each hole in bumper bar and remove lug bolts; then lower bumper and door assembly.

To close door, raise bumper and door assembly to closed position. Insert two attaching lug bolts and tighten firmly.

EMERGENCY DOOR

Emergency door incorporates an inside bar-type safety lock. Switch, mounted on door latch pillar and operated by the door lock bar, lights telltale in instrument panel and sounds alarm buzzer to indicate door is not closed and locked. Door should be inspected regularly to make sure of proper operation of door locking mechanism, telltale and buzzer. Refer to WIRING AND MISCELLANEOUS ELECTRICAL (SEC. 7) for information on alarm buzzer and to wiring diagram at rear of manual for checking of electrical circuits.

Door can be adjusted for tightness to body when closed, by repositioning lock bar on serrated lock shaft. Remove screw retaining lock bar flat washer to lock shaft. Reposition lock bar on shaft and check operation. Reinstall flat washer and retaining screw.

SASH AND GLASS

RUBBER INSERT RETAINED GLASS

A special insert-type rubber retainer seal is used to install glass in windshield, destination sign and rear windows. Windshield and rear window glass sections are retained in body openings with bonded seal retainer assemblies which eliminate cutting of retainer to install glass. Although possible to install retainer and seal insert without use of special tool, seal and insert installer tool (J-2189) (fig. 4) is recommended to facilitate installation.

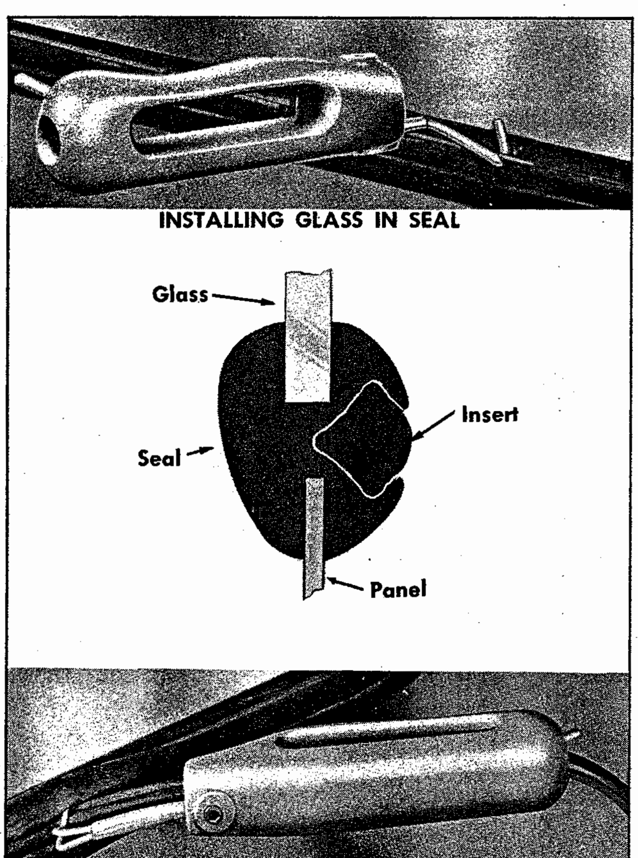


Figure 4—Installing Rubber Insert Retained Glass (Typical)

GLASS REMOVAL

1. Raise one end of insert out of groove in retainer seal with pointed tool; then pull insert from seal by hand.
2. Station an assistant outside vehicle to prevent glass falling; then push glass outward from inside coach.
3. Remove rubber retainer seal or seal assembly from panel by hand.

GLASS INSTALLATION

1. Straighten panel flange around opening to assure a good fit in retainer seal groove.
2. Position retainer seal in panel cut-out, making sure seal is pushed into place in corner. When installing glass in destination sign, make sure ends of seal come together at side of opening near top. Cut off retainer seal ends allowing sufficient overlap to secure a tight joint, then carefully butt seal into position.
3. Apply parafin to glass groove in retainer seal to facilitate glass installation.
4. Position glass to seal, then insert end of retainer seal installer tool (J-2189) in seal groove. Move tool along edge of glass forcing outer lip of seal over glass.
5. Thread end of rubber insert through handle and eye of seal installer rool (fig. 4). At point opposite joint in retainer seal, push tool eye and end of insert into seal groove. Feed into groove in retainer seal using a "hitching" motion to prevent elongation of insert.
6. Cut off insert, allowing sufficient overlap, and butt ends tightly into groove.

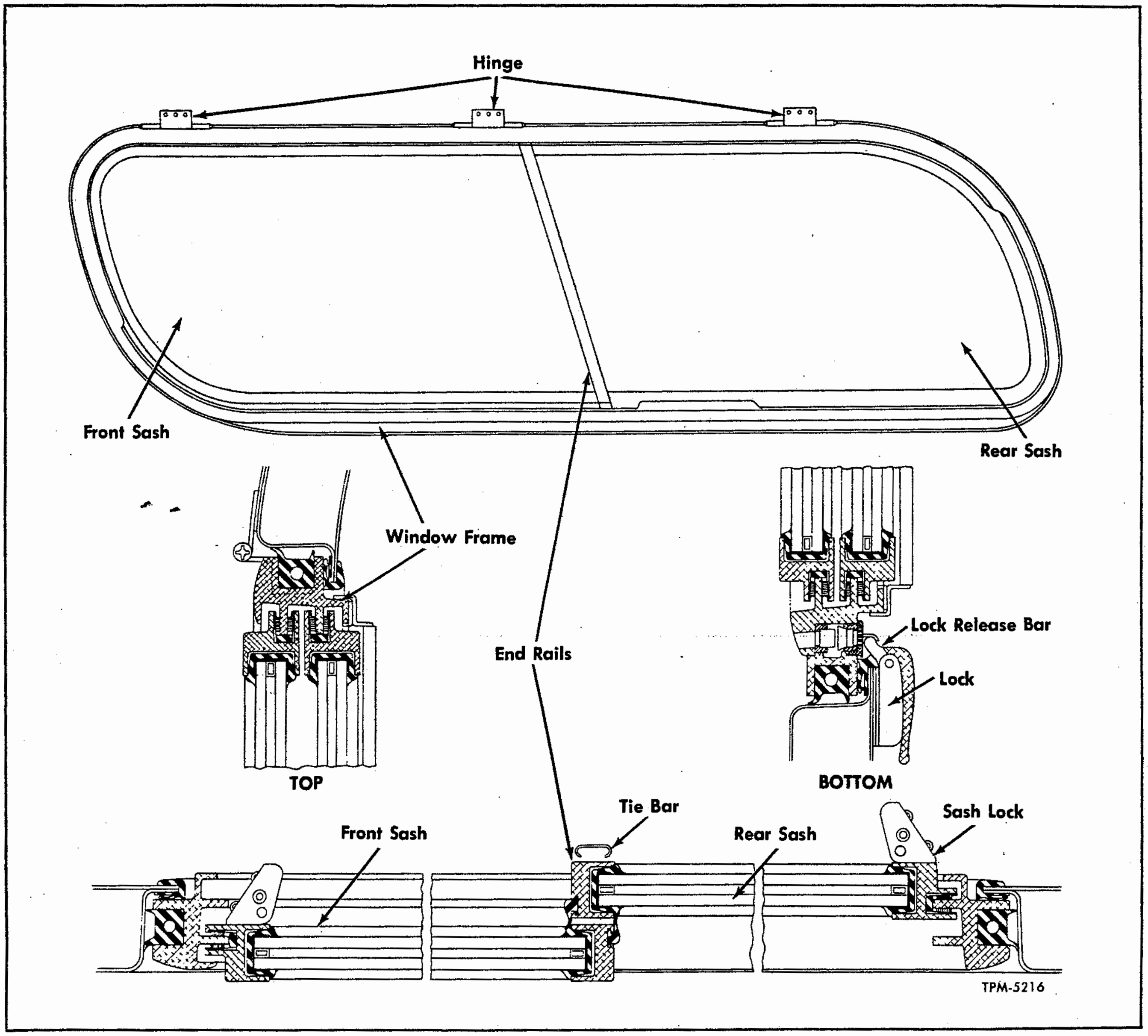


Figure 5—Side Window Long Sash

LONG SIDE WINDOW SASH

Long side windows consist of two sections of sliding sash and glass enclosed in a one-piece aluminum frame (fig. 5). Window can be opened by sliding front section rearward and rear section forward. Each section is retained in closed position by a latch type lock.

EMERGENCY ESCAPE

Side windows are hinged at top to provide passenger escape under emergency conditions. Window is held in closed position at bottom by three spring-loaded locks attached with screws to one long lock release bar (fig. 5). Pulling out and up on lock release bar will release window to emergency escape position.

SIDE WINDOW REMOVAL (Fig. 5)

Side window is readily removed after opening window to emergency release position. With the aid of an assistant to hold window, remove only one hinge pin retaining screw from each hinge pin; then remove pins from hinges and lower window.

SIDE WINDOW INSTALLATION

1. Before installing window, inspect window outer seal and replace if necessary.
2. Position window to opening in body; then insert hinge pins and install hinge pin retaining screws.

Close and open window several times to make sure emergency escape catches operate properly.

3. Lock release bar can be removed from locks by removing six screws which attach bar to locks. Each lock is attached to window panel with four screws.

SASH AND GLASS REMOVAL (Fig. 5)

1. Remove side window as previously directed under "Side Window Removal."

2. Remove four screws which attach window tie bar to top and bottom of window frame. Purpose of tie bar is to prevent window frame from spreading in the center when window is swung outward in emergency escape position.

3. Lay window on flat surface, and remove screw attaching sash stop to each side of window. Remove stop. Spread window frame in the center only enough to permit removing sash and glass sections from frame channels. Remove sash sections.

4. To disassemble sash and glass sections, pull out rubber seal at upper and lower end of section vertical-slanting end rail to permit removing two screws attaching end rail to sash. Remove screws and end rail. Carefully remove broken glass and glazing rubber from sash.

SASH AND GLASS INSTALLATION (Fig. 5)

1. Clean glass sash channels thoroughly.

2. Position new glazing rubber on glass; then using soap solution or parafin on glazing rubber to facilitate glass installation, install glass with rubber in sash.

3. Install vertical-slanting end rail to sash with attaching screws. Press seal into end rail over heads of end rail attaching screws.

4. Spread window frame apart at center only sufficiently to permit installing sash in frame channels; then install sash.

5. Install sash stops, one each side at top of window frame with screw.

6. Install tie bar to window frame with screws.

STATIONARY SIDE WINDOW SASH

The following sash assemblies are of stationary type: No. 1 right side (rear of entrance door), No. 1 left side (rear of driver), safety door, rear left quarter window, and sash in front of safety door.

NOTE: It is not necessary to remove glass frame from vehicle to replace glass.

1. To remove cracked or broken glass from glass frame, pry glass outer seal from sash channel in one place sufficiently to grasp with hand; then pull seal from around glass. Remove glass and glass inner seal from frame.

2. Glass with frame as a unit, can be removed from window opening by removing screws which attach glass frame to coach body. Screws are accessible under seal inside coach. With the aid of an assistant outside vehicle to prevent sash and frame from falling, push out on sash.

3. To install glass in glass frame, install glass inner seal in sash frame; then position glass to inner seal. Using parafin or a soap solution on on glass outer seal and in channel of sash frame to facilitate installation of seal, install seal between glass and frame. Cut off seal ends, allowing sufficient overlap to secure a tight joint; then butt ends of seal into position.

4. If glass frame was removed from coach, position frame in opening; then from inside of coach install screws attaching frame to body.

DRIVER'S WINDOW AND ENTRANCE DOOR WINDOW

Driver's window and entrance door window are practically the same in design except that rear section of driver's window is hinged and equipped with a small slide section for operator's use. Entrance door window rear section is not hinged and is of the stationary type.

Curved forward section of each window is hinged and will swing outward. To open front section of either window or rear section of driver's window, pull window regulator handle inward and toward window hinge. Push out on regulator handle to lock window in open position.

WINDOW REMOVAL

Driver's window assembly can be removed from coach after removing regulator handle bracket and hinge bracket screws attaching window to coach body. Entrance door window assembly can be removed from door after removing regulator bracket screws and screws which attach window rear section to door frame.

GLASS REPLACEMENT

Glass can be replaced in window sections after removing screws which attach window inner retainer moulding to window outer frame. Glass can be removed from small sections of driver's window after removing screws from ends of section frame. Remove all old glazing rubber from window framing.

Position new glazing rubber around glass and install glass with glazing rubber in window frame. Position window inner retainer moulding in place; then install inner retainer moulding to window outer frame with screws.

WINDOW INSTALLATION

Before installing windows in openings, inspect seals and replace if necessary. Snugness of window hinged sections to body seal can be adjusted by loosening regulator body bracket screws, shifting bracket; then retightening bracket screws.

MISCELLANEOUS EQUIPMENT

WINDSHIELD WIPERS

Two air-operated windshield wipers are mounted in front panels, below windshield. Air pressure for wiper operation is supplied by auxiliary air system, fed in turn from coach main air system. A pressure regulating valve, interposed in air lines (fig. 6), prevents depletion of main air system when pressure in main air system falls below approximately 65 p.s.i.

Windshield wiper motors are individually controlled by valves, mounted on dash panel below right side of instrument panel.

Refer to BRAKES (SEC. 4) for maintenance and repair information on auxiliary system air pressure regulator valve, air lines, and connections. Figure 6 illustrates typical systematic diagram of windshield wipers and controls. NOTE: Before disconnecting any wiper lines or replacing any wiper unit, deplete air pressure from auxiliary air system.

CONTROL VALVES AND WIPER SPEED ADJUSTMENT (TRICO TYPE WIPERS)

(Refer to Figure 7)

Each windshield wiper control valve is fitted with an adjustable needle valve on back of valve body, which prevents opening valve beyond a predetermined point. Purpose is to prevent operation of wiper motor at excessive speeds, with resultant rapid wear of motor.

Adjustment (Fig. 7)

NOTE: Maximum wiper speed must not exceed 140 strokes per minute on thoroughly wetted windshield. Proper adjustment cannot be made on dry windshield, or on one not kept thoroughly wet.

To adjust valve loosen lock nut, and bottom needle valve gently. Turn needle valve back one-half turn, and tighten lock nut. With air pressure at normal, wiper speed will be about 120 strokes per minute. One stroke means each time blade passes the center of wiper sweep.

WIPER SPEED ADJUSTMENT (SPRAGUE TYPE WIPERS)

At top of each wiper motor in the air exhaust line is located an adjustable control valve which controls the flow of exhausting air pressure from wiper motor (fig. 8). The rate of exhausting air pressure determines the maximum speed of wiper motor. Excessive speed may cause rapid wear of motor.

Adjustment (Fig. 8)

NOTE: Maximum wiper speed must not exceed 140 strokes per minute, on thoroughly wetted windshield. Proper adjustment cannot be made on dry windshield or on one not kept thoroughly wet. One stroke means each time blade passes the center of wiper sweep.

With air pressure at normal and windshield wiper control knob on dash panel in full open position turn the speed control valve at wiper motor to obtain 120 strokes per minute. This is the recommended wiper speed.

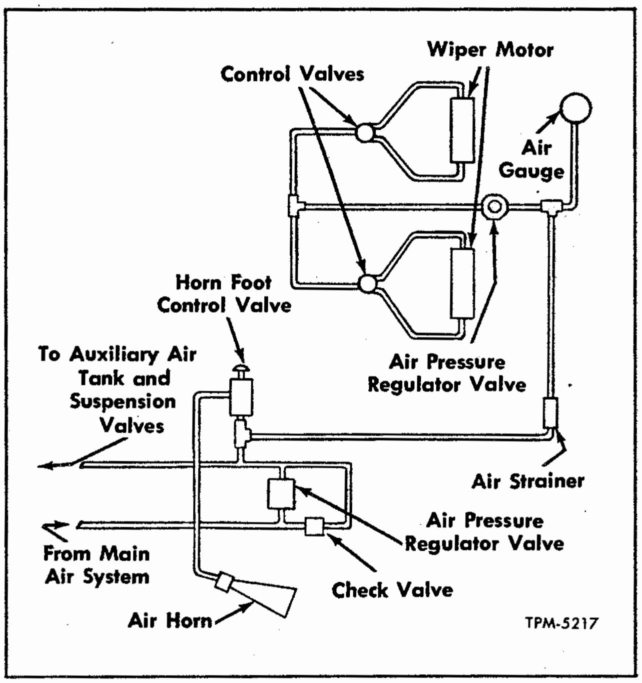


Figure 6—Windshield Wiper and Air Horn Air Line Diagram (Typical)

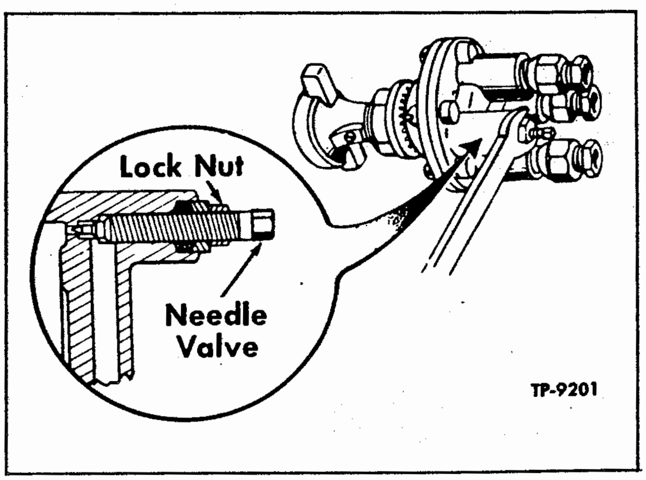


Figure 7—Windshield Wiper Speed Control Adjustments (Trico Type Wipers)

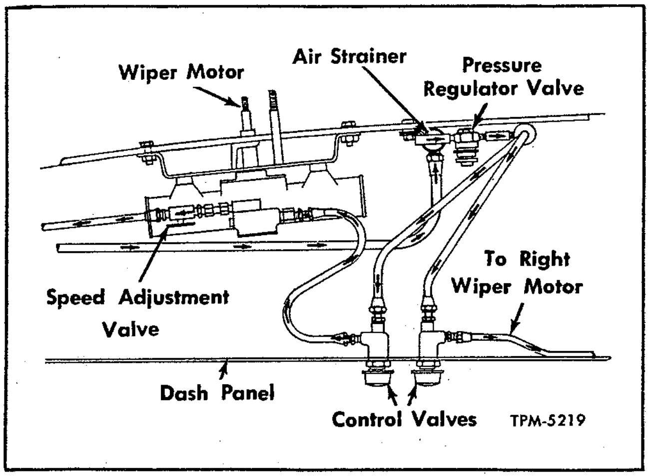


Figure 8—Windshield Wiper Maximum Speed Adjustment Valve Location (Sprague Type Wipers)

WIPER BLADE ANGLE ADJUSTMENT (SPRAGUE TYPE WIPERS)

Wiper blade angle should be adjusted to travel through complete sweep in a near vertical position. Adjustment is determined by length of pantograph shaft (fig. 9).

To shorten or lengthen pantograph shaft, loosen lock nuts (fig. 9) on shaft. Remove crown nut and flat washers which attach shaft arm to pivot rod. Pull shaft arm from rod then while holding shaft, turn shaft arm to shorten or lengthen shaft and arm assembly.

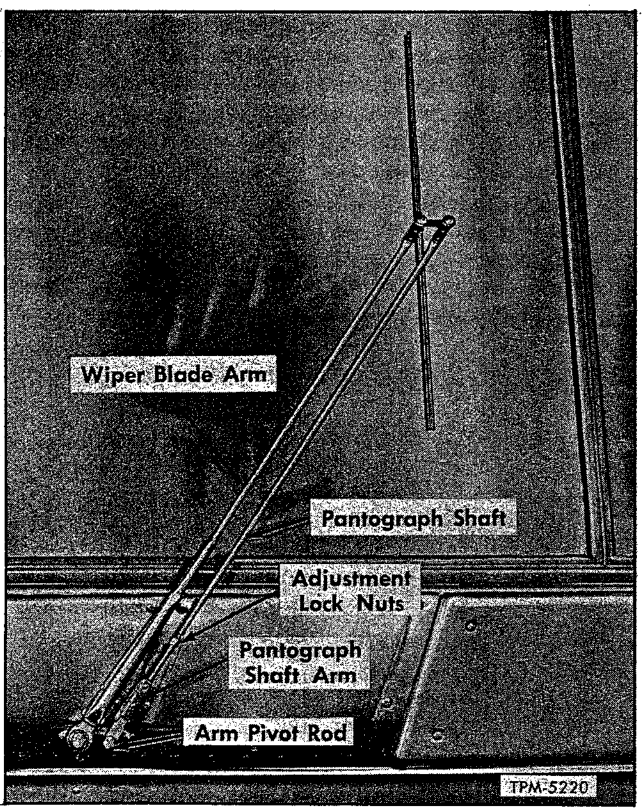


Figure 9—Wiper Blade Angle Adjustment (Sprague Type Wipers)

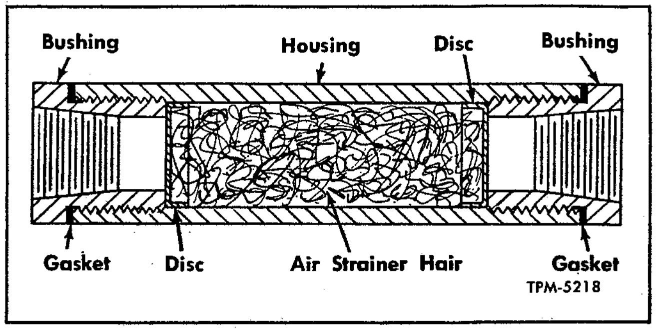


Figure 10—Windshield Wiper Air Strainer

Reinstall shaft and arm assembly and check blade angle.

NOTE: Tighten crown nut which attaches pantograph arm to pivot rod until nut is bottomed firmly. Too many flat washers under crown nut will cause binding with resultant rapid wear of wiper motor.

AIR STRAINER
(Refer to Figure 10)

Windshield wiper air strainer, mounted under dash, front of steering column should be removed, disassembled, and cleaned annually. Soak strainer filter in cleaning solvent to clean. Dry filter, then reassemble strainer. Tighten strainer end bushings firmly.

WINDSHIELD WIPER AIR PRESSURE REGULATOR VALVE

Air pressure regulator valve (fig. 11) is connected in air system as shown in figure 6. Valve mounted on panel in front of driver at right of steering column, controls the amount of air pressure for operating the wiper motors. Valve should be adjusted to regulate pressure at 80 to 85 psi while the wiper motors are in operation.

OPERATION

NOTE: Key numbers in text refer to figure 11.

Air, entering inlet port (8), flows past valve stem into diaphragm chamber (9). As pressure increases to valve setting, diaphragm (4) is raised against pressure of adjusting spring (2), permitting valve spring pressure to seat valve (6). Any pressure drop in chamber (9) will cause diaphragm to unseat valve, permitting further flow of air into diaphragm chamber.

TEST

Key numbers in text refer to figure 11.

NOTE: Make sure 85 psi exist in system before making test.

1. Loosen nut (11) and back off adjusting screw (1).

2. Remove plug from bottom of tee in line at right of regulator valve and install air pressure gauge.

3. Turn in regulator adjusting screw (1) until gauge registers 80 to 85 psi. Tighten adjusting screw nut (11). Remove gauge and reinstall plug in line tee.

DISASSEMBLY AND CLEANING

NOTE: Key numbers in text refer to figure 11.

1. Unscrew plug (7) and remove valve (6), with spring.

2. Remove adjusting screw (1) with lock nut (11), and remove adjusting spring (2).

3. Unscrew cap (3) from body (10) and remove diaphragm (4).

4. Clean metal parts in suitable solvent and wipe dry. Wipe diaphragm and valve clean with cloth dampened with cleaning solution.

5. Examine diaphragm and valve carefully. Replace, if parts are not in first class condition.

ASSEMBLY

NOTE: Key numbers in text refer to figure 11.

1. Position diaphragm (4) in body (10); then screw cap (3) into body.

2. Position adjusting spring (2) in valve cap; then start screw (1) in cap.

3. Position valve spring and valve (6) in plug (7). Install plug in body, tightening plug firmly.

INSTALLATION

Valve must be installed in air system so that air flow is in direction of arrow stamped on side of valve.

After installing valve, adjust air pressure setting as directed previously under "Test."

AIR HORNS

Dual air horns are mounted on brackets located in horn compartment. Horns are accessible from underneath left front corner of coach. Air pressure to horns is controlled by driver's foot control valve. Air pressure is supplied by auxiliary air system, obtained in turn, from main air system. Pressure regulating valve in air lines (fig. 6) prevents depletion of main air system by shutting off air to auxiliary air system when pressure in main system falls below approximately 65 pounds.

Refer to BRAKES (SEC. 4) for air line diagrams and information on air lines and connections. Pressure regulating valve maintenance and repair information is also contained in BRAKES (SEC. 4).

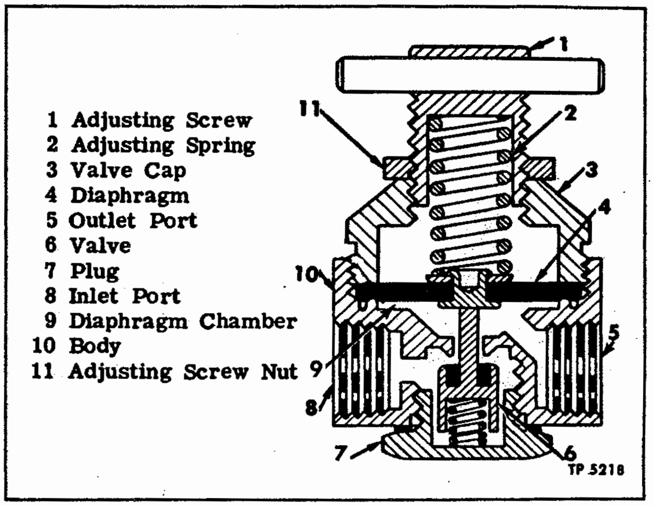


Figure 11—Windshield Wiper Pressure Regulator Valve

REPAIR

Sound is produced by a reed vibrating between two seats.

Horn is non-adjustable, and requires no maintenance.

In the event of horn failure, make sure that air system pressure is at least 75 lbs. Sticking reed may be cause of failure; usually reed can be freed without removing horn from vehicle. Tap horn bells or back of horn while assistant operates driver's foot control valve intermittently. If this fails to free reed, removal and disassembly of the horn is necessary. Seats can be cleaned with a flat oil stone. Since reeds act as air valves, reeds must be flat. If not flat, replace.

FOOT CONTROL VALVE (Fig. 12)

Valve, which controls operation of air horns, is mounted in driver's floor, with valve body ex-

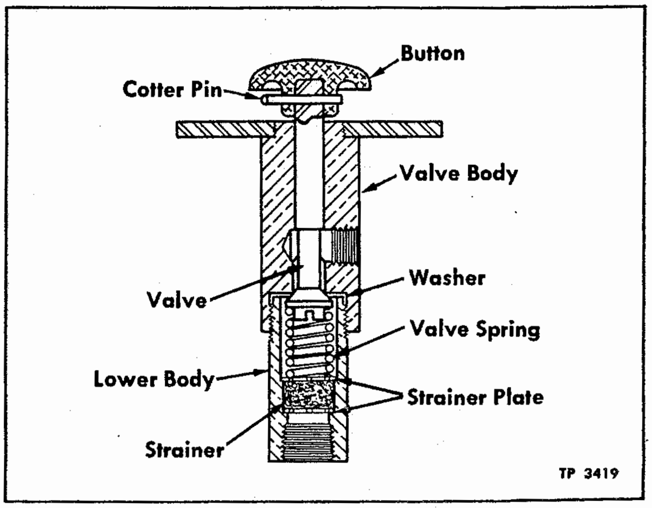


Figure 12—Air Horn Foot Valve

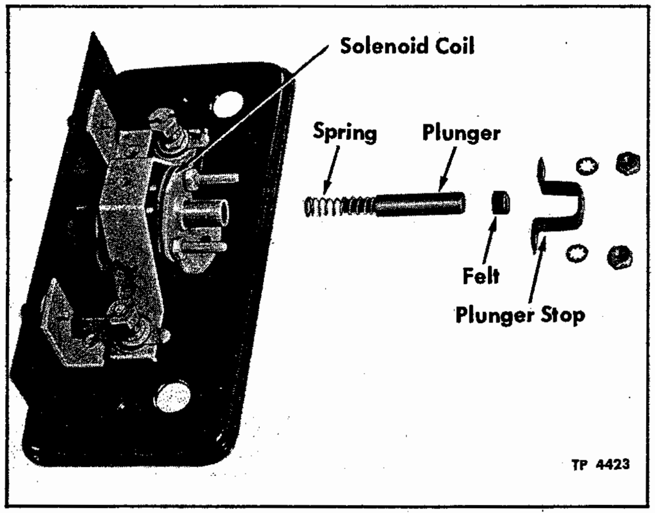


Figure 13—Passenger Signal Chime

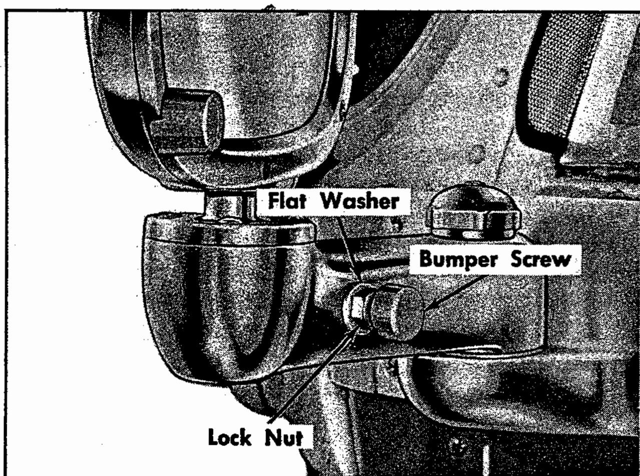
tending downward into tool compartment. Valve requires no maintenance, but can be easily checked for leakage with soap and water solution.

If leakage does occur, valve should be disassembled and lapped, using fine valve grinding compound. After grinding, wash all parts in gasoline and blow with compressed air to remove all traces of grinding compound.

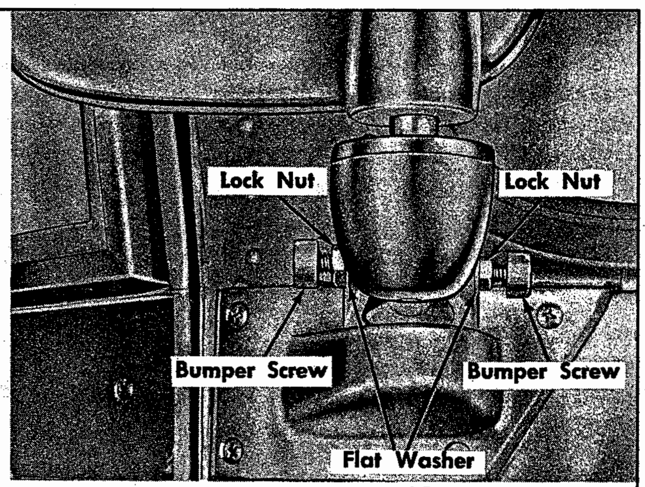
Whenever valve is disassembled, or in event of weak horn action, curled hair strainer in lower body should be cleaned. Lower body is threaded into valve body and is removed by unscrewing.

PASSENGER SIGNAL CHIME

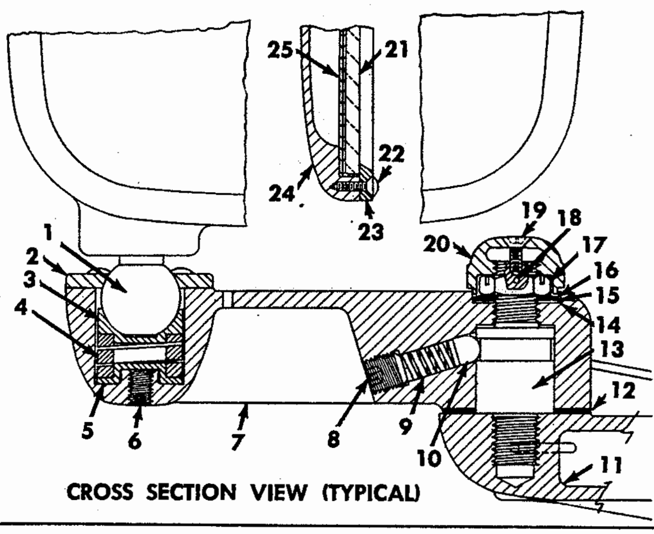
Passenger signal chime (fig. 13) is mounted on front panel at left of steering column. Chime is sounded by two switches, mounted under front ends of package racks. Switches are operated by pull cords at top of side windows. Chime circuit, fed



LEFT SIDE MIRROR



RIGHT SIDE MIRROR



CROSS SECTION VIEW (TYPICAL)

1 Ball Stud
2 Ball Stud Cap
3 Ball Stud Seat
4 Spring
5 Spring Seat
6 Set Screw
7 Mirror Arm
8 Set Screw (Some Coaches)
9 Tension Plug Spring (Some Coaches)
10 Tension Plug (Some Coaches)
11 Arm Stud Bracket
12 Fiber Washer
13 Arm Stud
14 Fiber Washer
15 Fiber Washer
16 Flat Steel Washer
17 Jam Nut
18 Pin
19 Screw
20 Cap Nut
21 Mirror Glass
22 Screw
23 Bezel
24 Mirror Head
25 Cork Tape

TPM-5285-1

Figure 14—Outside Rear View Mirrors (Typical)

through "RUN" position of engine control switch and "ON" position of buzzer switch is shown on "Alarm and Signal Wiring Diagram," at back of manual.

MAINTENANCE

Solenoid-type chime has no contacts and requires no regular maintenance.

If chime fails to operate with either switch, remove cover, which is of snap-on type. With engine control switch in "RUN" position, and buzzer switch in "ON" position, check for current indication at both terminals of chime. Current should be obtained at one terminal. Ground other (dead) terminal with jumper wire.

If chime now sounds, check circuit continuity from chime, through switches, to ground. If chime does not sound, make sure plunger operates freely. Disassemble chime as shown in figure 13. Failure may be due to burned out coil, or may be caused by felt positioned in such manner as to prevent operation of plunger.

Chime switch snap-on cover may be removed for inspection and cleaning of contacts.

OUTSIDE MIRRORS

Outside mirrors are equipped with replaceable glass sections which can be readily replaced if broken. To prevent breakage of windshield glass, driver's window glass or window glass by sudden slamming of arm or mirror head on some coaches, adjustable bumper screws are installed in mirror arms (fig. 14). Two bumper screws are employed in right mirror arm and one is employed at rear side of left mirror arm.

Mirror head-to-arm tension and the arm-to-coach bracket tension are adjustable as follows:

MIRROR HEAD TENSION ADJUSTMENT

NOTE: Key numbers in text refer to figure 14.

At bottom of mirror arm (7) tighten or loosen small hexagon socket head screw (6) which will tighten or loosen tension on mirror head ball stud (1). If necessary mirror arm assembly can be disassembled and tension components repaired or replaced.

MIRROR ARM-TO-BRACKET TENSION ADJUSTMENT

NOTE: Key numbers in text refer to figure 14.

1. At body end of mirror arm (7), remove small screw (19), retaining cap nut (20) to arm stud (13). Remove cap nut.

2. Remove roll pin (18) from jam nut, then loosen or tighten jam nut to obtain desired tension.

3. If necessary, arm can be disassembled and tension or friction components replaced.

MIRROR ARM STOP ADJUSTMENT
(When Equipped)

(Refer to figure 14, upper views)

1. At side of mirror arm, loosen lock nut retaining bumper screw to arm.

2. With mirror arm-to-bracket tension relaxed, swing arm each way to extreme end of travel arc, contacting coach body, windshield, or window glass. Turn out bumper screw to provide sufficient clearance to prevent glass, body or mirror damage. Secure bumper screw by tightening bumper screw lock nut.

DISASSEMBLY OF MIRROR ARM

NOTE: Key numbers in text refer to figure 14.

1. At mirror end of arm, loosen set screw (6) to relieve spring tension on ball stud (1).

2. Remove four screws which attach ball stud cap (2) to mirror arm (7). Remove cap, ball stud (1), ball stud seat (3), spring (4), and spring seat (5) from arm.

3. At bracket end of arm, remove screw (19) attaching cap nut (20) to arm stud (13). Remove cap nut.

4. Remove pin (18) from jam nut (17), then remove nut, flat steel washer (16) and two fiber washers (14 and 15) from arm stud.

5. On some coaches only remove socket head set screw (8), tension plug spring (9), and tension plug (10) from mirror arm (7). Remove arm from stud, then remove large fiber washer (12) from arm-stud bracket.

ASSEMBLY OF MIRROR ARM

Assemble arm in reverse of disassembly procedures above.

MIRROR GLASS REPLACEMENT

NOTE: Key numbers in text refer to figure 14.

1. Remove eight screws (22) which attach mirror bezel (23) to mirror head (24), then with a thin blade tool pry bezel from head. Wearing gloves to protect hands, remove broken mirror glass (21) and cork tape (25) from mirror head.

Install new cork tape (25) around edge of mirror glass and position glass with tape in mirror head. Position bezel (23) over glass to head and secure with eight screws (22). IMPORTANT: Tighten screws evenly and firmly.

Heating and Ventilation

Information contained herein applies only to the standard GM heating and ventilation system, and does not include information on any air conditioning units except operation and maintenance of blower used in conjunction with the standard GM air conditioning system and the air conditioning cooling system draining, bleeding, and filling.

Refer to figure 16 for air circulation diagram.

HEATING SYSTEM

DESCRIPTION

Interior of coach is heated by an underfloor, hot water, forced air heating system which is entirely automatic except for manually operated "MASTER SWITCH" on control panel at left of operator.

Hot water is supplied to one large heater core by the engine cooling system.

Warm air is forced from heating and cooling compartment into ducts and distributed throughout coach.

Heater core, blower and motor are located in compartment under floor at rear of front axle accessible through right front baggage compartment (fig. 15). Water modulation valve, connected into heater water lines, is mounted to top of same compartment.

Some coaches are equipped with an electrically driven booster water pump mounted at left rear corner of coaches above engine radiator. Pump which is accessible after opening engine compartment rear left door, assists the engine water pump in circulating water through the heating system.

Water modulation valve Grad-U-Stat (thermostatically operated air pressure control valve) is mounted in recirculated air inlet on floor under second seat from front on right side of aisle.

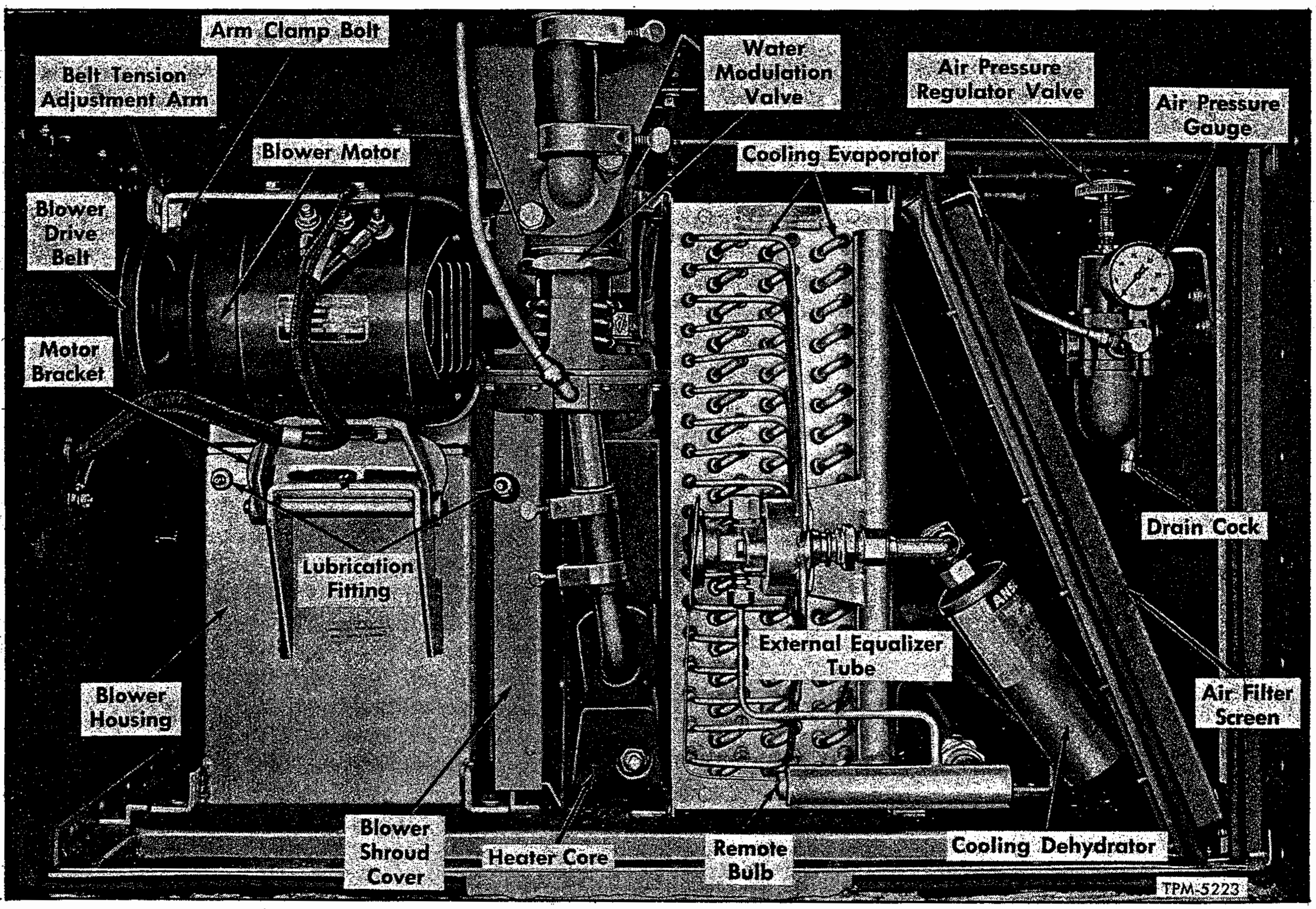


Figure 15—Heating, Cooling, and Blower Compartment

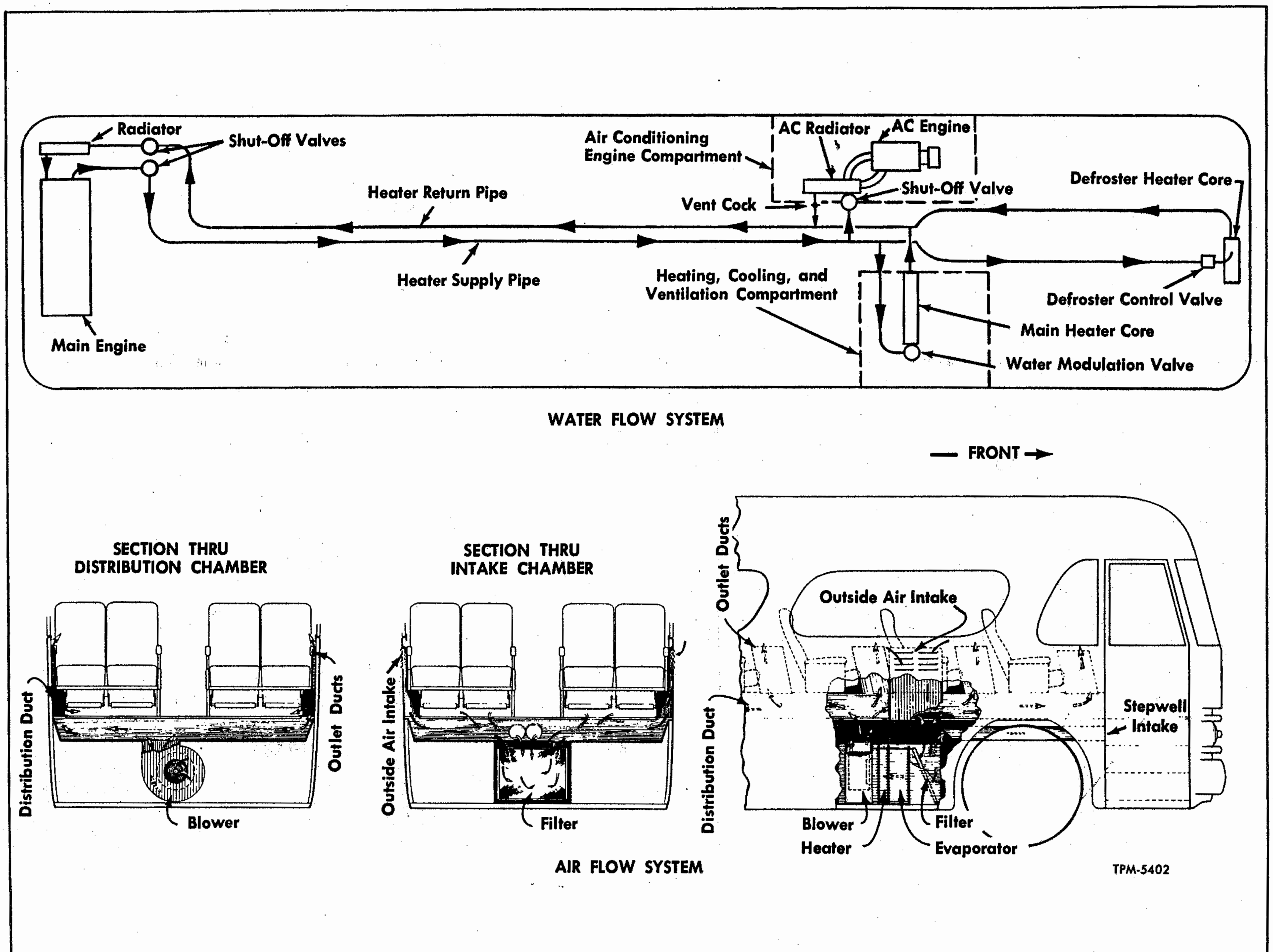


Figure 16—Heating, Cooling, and Ventilation System

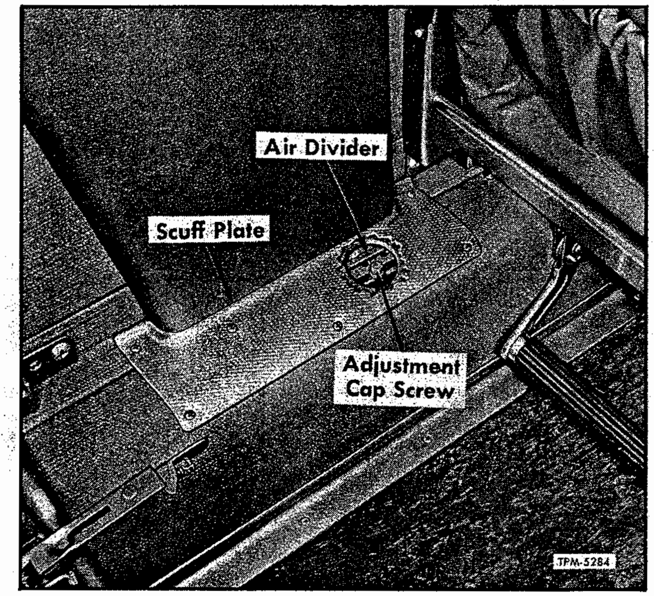


Figure 17—Air Duct Divider Location

Defroster heater, located behind dash center closure panel, includes a heater core, two blowers and a manually adjusted thermostatic control valve. Hand controlled damper directs flow of air toward driver. Outside air is admitted to front heater by impact or is drawn in by blowers. Amount of outside air is controlled by a damper which can be set manually to desired opening.

Main heating control switch which is integral with the air conditioning control switch is located on control panel at left of driver. Refer to "Heating and Ventilating Wiring Diagram" at back of this manual.

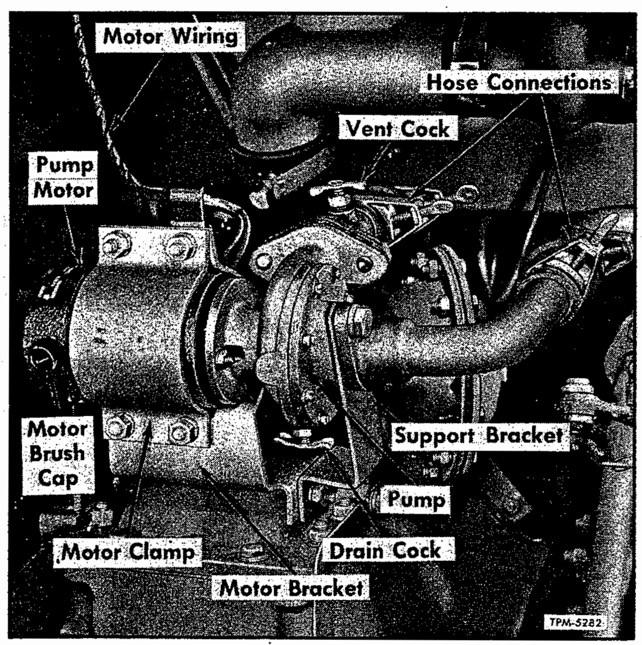


Figure 18—Booster Water Pump Installed

Defroster heater control switch located on control panel at right side of driver, is of two-speed (High and Low) type and is used in conjunction with defroster blower motor relay. Refer to "Heating and Ventilating Wiring Diagram" at back of this manual.

OPERATION

Air Circulation (Fig. 16)

Under-floor heater blower runs continuously at constant speed when "MASTER SWITCH" is turned to "HEATING" position. Blower draws outside air into heating compartment through a perforated opening in each side of coach below forward windows. Desired amount of outside air is controlled by a manually operated damper in each recirculated air inlet located under second seat from front on each side of aisle.

Both outside air and recirculated air are drawn into heating and cooling compartment and distributed through longitudinal ducts along each side at base of wall and vertical wall ducts between each seat. Thermostatically operated outlets in floor ducts distribute heated air over floor and passengers feet.

Air divider (fig. 17) located in longitudinal duct at each side of coach provide adjustable means of controlling the volume of circulating air to front and rear of coach.

Air to left side of driver's seat is admitted from duct at base of left wall by manually controlled damper which also act as deflectors.

Recirculated air is drawn into heating compartment through openings in stepwell and under one seat on each side of aisle.

Air forced through defroster heater core may be recirculated air or outside air as desired by manual positioning of outside air inlet damper at left side of heater core under dash.

Both the main underfloor blower and the defroster blower tend to pressurize coach when one or more outside air intake control dampers are in open position. Exhaust air is released through lowered openings in entrance door.

Water Circulation (Fig. 16)

Hot water from the engine cooling system is forced through the heater supply line by the engine water pump. On some vehicles, engine water pump is assisted by an electrical booster pump (fig. 18). Actual flow of water through the under-floor heater core is controlled by the modulation valve, and flow of water through the defroster heater core is controlled by the manually adjusted thermostatic control valve. Water modulation valve is air-operated, the air pressure delivered to it being

graduated by the Grad-U-Stat, which is sensitive to inside coach temperature. After circulating through heater cores, water flows through the return line to the suction side of the engine water pump. Some of the water in return line is circulated through a branch line, through the air conditioning engine cooling system. This action occurs only when the AC engine is operating. The AC engine cooling system can be isolated from the heating system by shut-off valves in supply line and vent line at top of AC radiator. Two gate valves, one in heater supply line and one in return line, provide means of isolating both the heating system and air conditioning engine cooling system from the main engine cooling system, or to permit working on main engine system without draining heating and air conditioning systems or vise-versa. Valves are located in engine compartment.

IMPORTANT: These gate valves should not be closed while the AC unit is being operated as there would be no means of replenishing water supply to the AC engine.

Booster water pump is energized to circulate water through heating system when the following occurs:

1. When defroster heater motor switch is placed in "High" or "Low" speed position.
2. While the engine control switch is in "ON" position and thermostat is calling for heat.
3. When the toggle switch mounted in the radiator surge tank filler compartment is held in "WATER BOOSTER PUMP" position. This latter control serves to bleed heating system. See "Bleeding" as explained later under "Maintenance."

MAINTENANCE

General

1. Heating system and air conditioning engine cooling system should be flushed semi-annually, following same general procedure described for flushing main engine cooling system in "COOLING SYSTEM - GENERAL" (SEC. 6).
2. At regular intervals, examine heater pipe joints and fittings, and heater cores for leakage and make the necessary repairs. Clean all dirt from heater cores.
3. Check for proper operation of heater motors, Grad-U-Stat, water modulation valve, and magnetic switches at beginning of each heating season.
4. Drain plug is provided at bottom of pressure regulator valve for draining collected moisture. Pressure regulator valve is located in underfloor heating and cooling compartment. Valve should be drained at regular intervals.
5. Possible causes of improper heating are explained at end of this section under "Heating System Trouble Shooting Guide."

Draining

1. If heating system or the air conditioning system or both, are to be drained without draining main engine cooling system, close two gate valves in engine compartment.
2. Remove drain plug from bottom of underfloor heater core. Plug is accessible after entering right forward baggage compartment and opening left inner heating compartment door.
3. Open two drain cocks in heater water lines, located in compartment under defroster heater. Drain cocks are accessible after removing dash center closure panel and reaching down into compartment. See figure 26.
4. If vehicle is equipped with booster water pump, open drain cock at bottom of pump body.
5. Two drain cocks are provided for draining the air conditioning engine cooling system. One drain cock is located in bottom of radiator outlet fitting, and one is located in engine cylinder block at left (inner) side. Both cocks are accessible from under vehicle. See figure 39 in "AIR CONDITIONING" (SEC. 26).
6. Open AC engine cylinder head water outlet vent cock on compartment ceiling to admit air.

Filling

1. Make certain all drain and vent cocks are closed, that heater line gate valves in engine compartment are open, and that the defroster heater control valve knob is turned completely clockwise to full open position. If coach is equipped with air conditioning, open valve in AC system supply line and valve in system vent line. Valves are located above AC radiator (fig. 38, Sec. 26). Also open AC engine cylinder head water outlet vent cock (7, fig. 37, Sec. 26) on AC compartment ceiling. Close vent cock when water flows in a solid stream while filling.
2. Fill heating system in same conventional manner as explained in COOLING SYSTEM (SEC. 6) for filling engine cooling system.

On coaches equipped with booster water pump, the pump can be energized to assist in circulating fluid through heating system. Pump is operated by switch located in surge tank compartment. Open vent cock in pump outlet to vent the pump before operating.

Bleeding

Whenever engine cooling, coach heating system or air conditioning cooling have been drained and refilled, when systems have run low and water is replenished, or whenever sufficient air has accumulated in system to retard normal flow of water, heating system should be bled to expel air.

Before bleeding system make sure all drain and vent cocks are closed, that heater line gate valves in engine compartment are open, and that

the defroster heater control valve knob is turned clockwise to full-open position.

NOTE: On coaches equipped with booster water pump it is not necessary to open any vents in heating system. However, the AC cylinder head water outlet vent cock on compartment ceiling (7, fig. 37, Sec. 26) must be opened to bleed AC system. Operate booster water pump for short period of time to bleed heating system. Pump is operated by switch in surge tank compartment.

On coaches not equipped with booster water pump perform the following:

1. Operate engine at half throttle.
2. Using a screwdriver open vent screw (fig. 26) at upper left corner of defroster heater core. Vent screw is accessible through small hole in dash center closure panel. Close vent screw when all air is expelled.
3. Open vent cock at upper corner of underfloor heater core. Vent cock is accessible after entering right forward baggage compartment and opening left inner compartment door. Close vent cock when all air is expelled.
4. Slow engine down to normal idle and replenish engine cooling system if required.
5. If coach is equipped with air conditioning, vent AC engine as mentioned above. Close vent cock after expelling air.

WARM AIR THERMOSTATS

Warm air thermostats, located in right and left longitudinal floor ducts, permit distribution of warm air onto feet of passengers. Thermostats consist of a valve actuated by a thermostatic element. Valve starts to open at 100°F. and continues to open gradually as temperature increases in duct. Thermostat is not adjustable, its action being determined by design of element. Thermostat is attached to duct with two screws.

Inspect and test thermostats in the following manner:

1. Visually inspect thermostat bellows and valve. Valve should be firmly seated at temperatures less than 100°F. If valve is partially open, thermostat should be replaced.
2. To test operation, place unit in water 100°F. or above. Submerge unit completely and agitate water thoroughly. The thermostat valve should open fully at 120°F.
3. Remove thermostat from water 100°F. or above and submerge in water having temperature lower than 100°F. Valve should close completely.
4. If thermostat does not open or close, replace.

AIR DIVIDERS

Distribution of circulating air to front or rear of coach is regulated by the position of air dividers located in longitudinal ducts each side of coach (fig. 17). Air dividers are accessible from rear of second seats after removing scuff plate from top of longitudinal ducts. If necessary to change adjustment, remove scuff plate, then loosen air divider adjustment cap screw. Slide divider forward to lower the volume of air to front of coach which will permit an increase in volume to rear of coach. Divider positioned rearward will cause the opposite condition. A midway position of divider should allow a balanced flow to both front and rear of coach. After making adjustment, tighten divider cap screw firmly and reinstall scuff plate.

BOOSTER WATER PUMP

Booster water pump as used on some coaches, is mounted at the left rear corner of vehicle above the engine radiator (fig. 18).

Pump operation is explained previously under "Water Circulation."

Refer to ELECTRICAL (SEC. 7) for information on relays used in conjunction with pump operation. Wiring diagrams are located in pocket at rear of this manual.

Pump assembly can be removed for service; however, it is not necessary to remove pump and motor to replace motor brushes. Remove pump with motor as a unit.

REMOVAL (Refer to Fig. 18)

1. Drain cooling system to slightly below pump level.
2. Disconnect electrical wiring at motor.
3. Disconnect water lines at hose connections.
4. Remove four bolts, nuts, and lock washers which attach pump motor clamp to motor bracket and remove nuts from two bolts which attach pump support bracket to motor bracket. Remove pump with support bracket and motor.

DISASSEMBLY (Refer to Fig. 19)

1. Remove eight screws and washers from adapter flange, then remove adapter flange, being careful to avoid damaging flange gasket.
2. Remove nuts from studs which attach pump body to motor.
3. Install special tool (80-0202) on pump body, attaching tool with flange screws.
4. Turn puller screw to force motor shaft through hub of impeller. Remove motor from pump body.
5. Remove special tool from pump body; then remove impeller, bellows, and seal washer.
6. Remove floating seat by pressing with fingers from motor side of pump.

CLEANING, INSPECTION, AND REPAIR

1. Check condition of seal. If seal is worn or damaged, replace with new seal assembly. Use

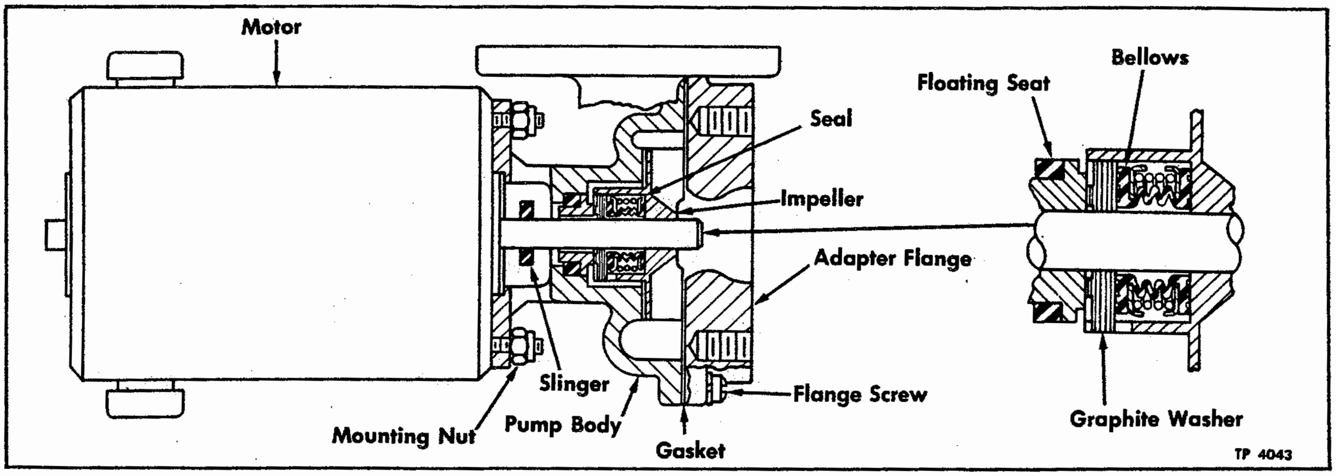


Figure 19—Booster Water Pump

care to prevent scratching or marring of seal surfaces.

2. Clean inside of water pump body to remove any foreign matter which may have entered pump.
3. Make certain that slinger is tight on motor shaft. If not tight, replace with new slinger.
4. Impeller is a press fit on shaft. If impeller was loose on shaft, replace with a new impeller.
5. Clean floating seat in cleaning solvent to remove all dirt and dust.
6. Check operation of water pump motor.

PUMP MOTOR

Water pump motor is equipped with sealed bearings. Motor is non-reparable in the field. However, brushes can be readily replaced. Remove brush caps shown in figure 18, then replace brushes and springs if necessary.

ASSEMBLY (Refer to Fig. 19)

1. Install floating seat in recess in pump body. Apply a drop of light oil to neoprene ring to facilitate installation.
2. Make sure that floating seat is fully bottomed in pump body around entire circumference. Apply a drop of very light machine oil to wearing face of seat.
3. Hold impeller with vanes downward. Insert bellows in recess of impeller. Position graphite washer on top of bellows. Make sure that proper surface of graphite washer is positioned for contact with floating seat. Line up tangs of graphite washer with slots in impeller.
4. Position pump body over impeller. Visually center impeller in pump body.
5. Remove puller screw from special tool (80-0202). Install tool on pump body, attaching tool with screws. DO NOT USE GASKET BETWEEN TOOL AND PUMP BODY.
6. Make sure slinger is properly positioned on motor shaft. Insert motor shaft in pump with motor vertical and shaft at bottom, until shaft contacts impeller hub.
7. Align motor mounting studs with holes in pump flange. Position pump and motor in arbor press, and apply pressure to end of shaft at top end of motor until end of motor contacts pump flange.
8. Remove pump tool from pump body. Face of impeller should be flush with face of body, gasket provides necessary clearance. Apply a very thin coat of gasket cement to both sides of gasket, then install gasket and adapter flange. Tighten screws firmly.

INSTALLATION OF PUMP AND MOTOR
(Refer to Fig. 18)

1. Apply gasket cement to pump body line adapter and to line flanges (if flanges were separated) and to pump support bracket. Position pump, pump support and motor assembly on mounting bracket and secure with clamp.
2. Reconnect lines to pump using new gaskets. Make sure connections are tight. If pipes were not separated from pump body, engage hose connections. Tighten clamps firmly.
3. Connect electrical wiring.
4. Fill heating and air conditioning systems as previously instructed under "Filling."

GRAD-U-STAT

DESCRIPTION

Grad-U-Stat (fig. 20), which is a thermostatically operated control valve, is installed in recirculated air floor inlet located under second seat from front on right side of aisle (fig. 21). Two air lines connect to unit. Main air line, connected to port next to aisle is the (M) main feed line from air pressure regulating valve, which limits the air

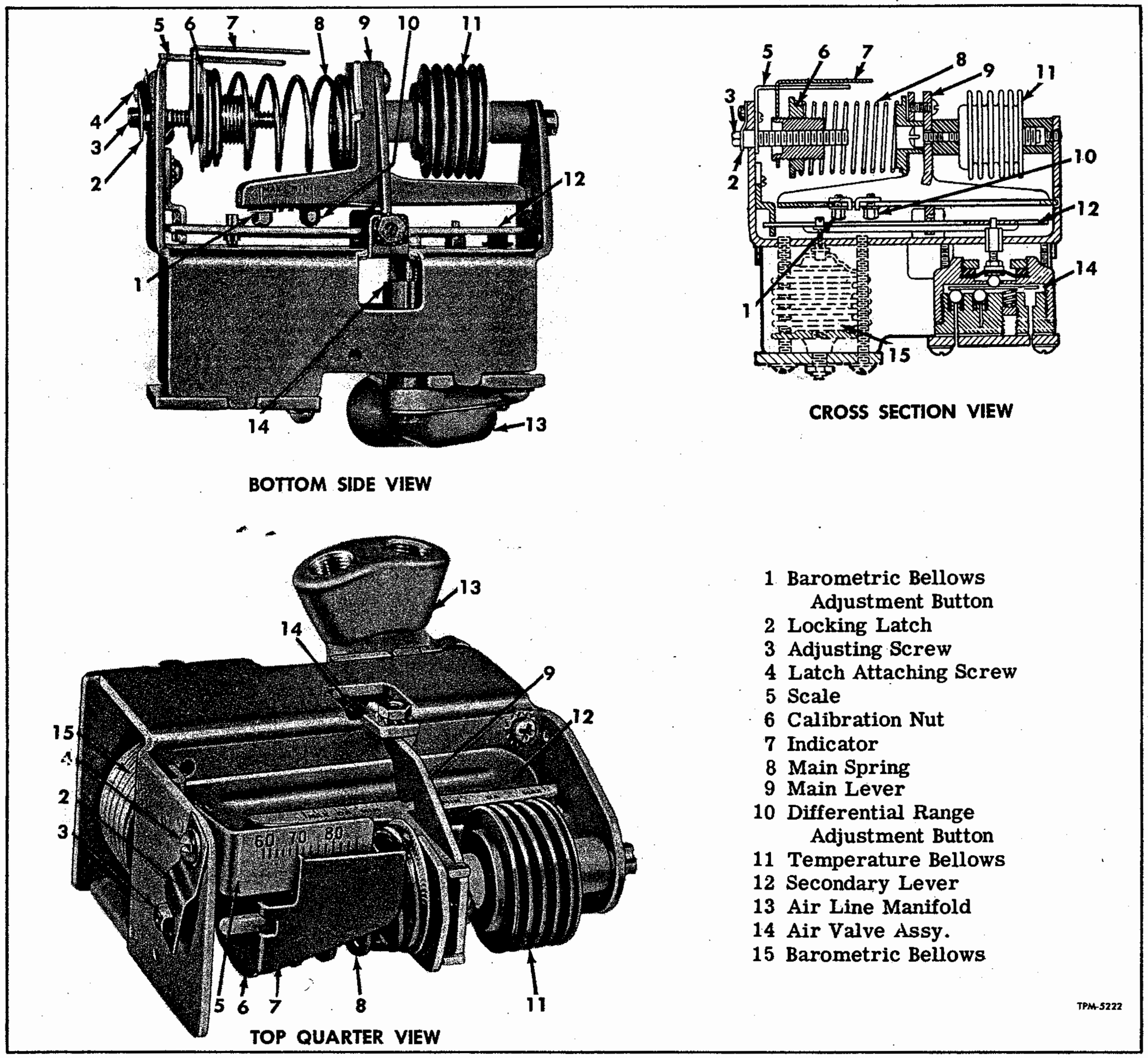


Figure 20—Heating System Grad-U-Stat

pressure to 10 lbs; other line carries air pressure from unit to water modulation valve.

Vapor filled temperature bellows in unit is sensitive to inside coach temperature. Expansion and contraction of bellows, caused by increasing and decreasing coach temperatures, is transmitted to air control valves in lower portion of unit through levers.

An auxiliary bellows, unaffected by temperature changes, opposes the effect of altitude changes on the temperature sensing bellows.

OPERATION

NOTE: Key letters in text refer to figure 22, however, throughout explanation of Grad-U-Stat Operation, reference is made to simplified diagrams shown in figure 23 which illustrate reaction of Grad-U-Stat under varied temperature conditions.

As temperature in coach rises, bellows (A) expands and exerts downward force on secondary lever (C) through main lever (B) and adjusting button (D). Downward movement of secondary lever is transmitted to lever (E) in air control chamber (F) of unit, increasing air pressure delivered to

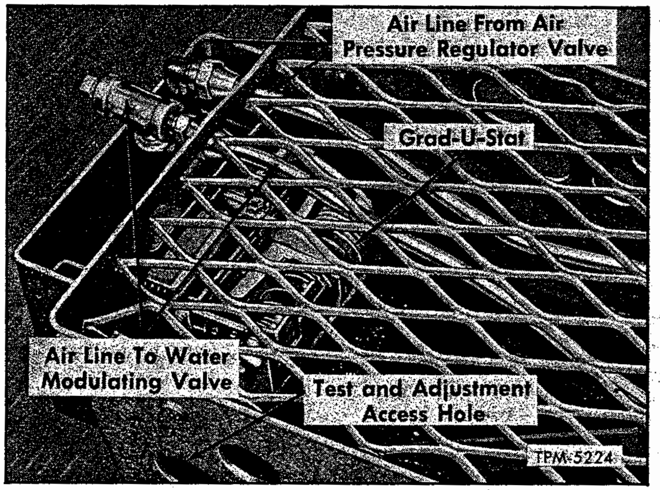


Figure 21—Grad-U-Stat Installed

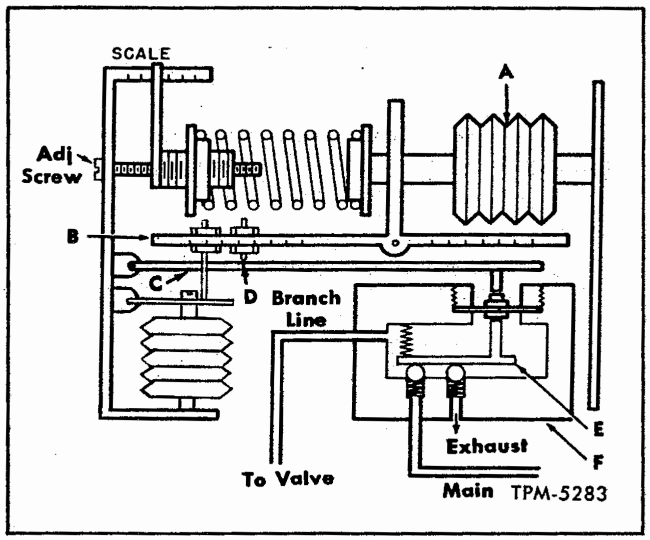


Figure 22—Grad-U-Stat Diagram

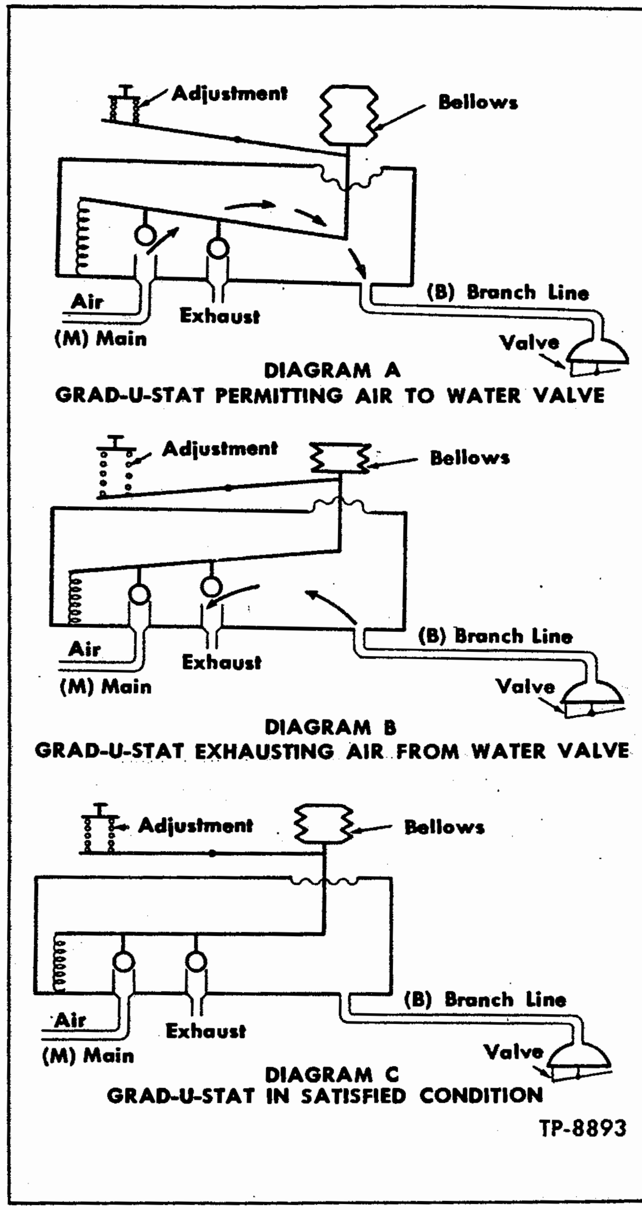


Figure 23—Grad-U-Stat Operational Diagrams

water modulation valve as shown in diagram A, figure 22. This increased air pressure at the modulation valve causes the valve to close, reducing the flow of water through the heater core.

When temperature in coach lowers, the bellows (A) contracts and relieves pressure exerted in air control valve lever (E). Air valve then exhaust air pressure from water modulation valve, increasing the flow of water through the heater core as shown in diagram B, figure 23. The air pressure delivered by the Grad-U-Stat varies in proportion to the inside coach temperature acting upon the bellows; thus, flow of water through underfloor heater core is graduated as required in accordance with inside coach temperature. Diagram "C" figure 22, shows status of Grad-U-Stat when temperature in coach is approximately equal to temperature setting on Grad-U-Stat.

The differential range adjustment button (10, fig. 20) on the main lever is set at the factory to provide a 6 F. differential between fully closed and fully opened position. This setting has been found satisfactory for most operations and it is recommended that setting not be changed.

Grad-U-Stat is also altitude compensated, providing uniform temperature control when coach is operating at various elevations. An auxiliary bellows (15, fig. 20), unaffected by temperature changes, opposes the effect of altitude changes on the temperature-sensing bellows by retarding action of the secondary lever.

If the air screen located under seat becomes

HEATING AND VENTILATION

clogged, flow of air over coils of Grad-U-Stat will effect efficiency of unit.

MAINTENANCE

1. Brush away all loose dirt or dust. If operation is restricted by corrosion or foreign material that cannot be brushed away, clean unit with a solvent, such as trichlorethylene. Recalibrate the Grad-U-Stat if the adjustments have been disturbed. See "Test and Adjustment " below.

2. Inspect the bellows. Dust will insulate the bellows and cause sluggish action.

3. Check the adjustment screw for binding; if it turns hard, clean, then coat it lightly with lubricant. Reset adjustment screw after lubricating.

TEST AND ADJUSTMENT

Key numbers in text refer to figure 20.

1. Remove inner cushion from second seat from front of coach on right side of aisle.

2. Shut off air supply to Grad-U-Stat at pressure regulator valve in heating compartment. Turn regulator screw completely counterclockwise to shut off air.

3. Disconnect Grad-U-Stat to water valve air line elbow (fig. 21); then install air pressure test gauge in this circuit.

4. Open air supply to unit by turning air pressure regulator valve screw clockwise, until pressure gauge at air pressure regulator valve indicates 10 lbs. pressure.

5. Check the air temperature at the bellows with an accurate thermometer. IMPORTANT: Do not touch the bellows with hand while accomplishing the following operations, as body heat will affect both units and erroneous readings and adjustments will be obtained.

6. Through hole in side of air inlet riser, loosen locking latch screw (4), disengage latch (2) from adjusting screw (3), then turn the adjusting screw to set the indicator at the temperature shown on the thermometer.

7. Observe pressure reading on air pressure test gauge. If reading is 4-1/2 pounds, no adjustment is required. If pressure is above 4-1/2 pounds, turn the calibration nut (6) and main spring (8) to shorten the spring until the correct reading (4-1/2 pounds) is obtained. If pressure is below 4-1/2 pounds, turn calibration nut and main spring to lengthen the spring.

8. After correct adjustment is obtained, turn adjusting screw (3) to set the indicator at desired operating temperature (75°F. is factory setting), place locking latch (2) over adjusting screw, and tighten latch screw (4).

9. To check the differential range, find the temperature setting at which the pressure in line to water valve is 3 psi and the temperature setting at which line pressure is 10 psi. The number of degrees the setting must be changed to raise line pressure from 3 to 10 psi is the approximate differential range. If necessary change setting as follows:

a. Using a small open-end wrench, loosen the differential range button (10, fig. 20). Move the button to the desired position on its scale, and retighten range button. NOTE: To perform this operation it is necessary to return the screen from air inlet.

b. Make sure differential range button is between the MAX. and MIN. markings on side of main lever (9, fig. 20). Maximum range is 10 degrees, minimum range is 3 degrees.

10. Remove test gauge and reconnect air line.

11. Install screen in recirculated air inlet.

12. Open air supply to Grad-U-Stat.

REMOVAL OF GRAD-U-STAT (Fig. 21)

1. Shut off air supply to Grad-U-Stat at pressure regulator valve in heating and cooling compartment. Turn regulator screw completely counterclockwise to shut off air supply.

2. Remove screen from air inlet, then disconnect air lines at unit.

3. Remove screws which attach unit and mounting bracket to recirculated air inlet.

4. Remove screws which attach unit to mounting brackets.

INSTALLATION OF GRAD-U-STAT (Fig. 21)

1. Attach Grad-U-Stat to mounting bracket with screws; then install unit with mounting bracket to recirculated air inlet.

2. Connect air pressure regulator air line to elbow closest to aisle (fig. 21). Connect air pressure test gauge and other line to opposite fitting.

3. Test Grad-U-Stat operation, and adjust if necessary, then complete the installation as previously directed under "Test and Adjustment."

WATER MODULATION VALVE

Water modulation valve (fig. 24) is an air operated water control valve installed in supply line leading to underfloor heater core. Modulation valve controls the flow of warm water through the heater core in accordance with the air pressure delivered to it by the Grad-U-Stat.

Modulation valve is mounted on under-side of floor in right forward baggage compartment (fig. 15); and is secured to two mounting brackets with four cap screws. Valve is protected by a cover which is attached to valve mounting brackets attaching cap screws.

MAINTENANCE

1. Visually inspect for broken or kinked air line and broken or damaged parts.

2. Apply soapy water to air line connection and to exposed edges of diaphragm. Unless coach is abnormally cold, leakage will be indicated by bubbles.

3. Use compressed air to blow dust and dirt from area around spring. Cleaning solvents such as trichloroethylene may also be used.

4. Check the valve packing for leakage.

NOTE: The packing nut (4, fig. 24) is self-adjusting; excessive tightening will not stop packing from leaking. The packing must however, be threaded completely into bonnet.

5. If leakage cannot be stopped, repack valve as explained later under "Repacking Valve."

REMOVAL OF MODULATION VALVE

1. Remove modulation valve protection cover from valve mounting bracket cap screws by removing four nuts and washers.

2. Shut off air supply to valve by turning regulating screw at pressure regulator valve completely counterclockwise; then disconnect air line from modulation valve.

3. Drain heating water system as previously directed under "Draining."

4. Remove four cap screws which attach valve flanges to water line fittings and valve mounting brackets. Lower valve assembly from between mounting brackets and line fittings.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 24.

1. Unscrew valve bonnet (9) with valve mechanism from valve body (13).

2. Using a screwdriver through opening in spider (17), pry stem coupling lock (21) in or out to uncouple stem (3) from lock.

3. Place mark on cover (1) and outer spider (17) to assure assembly of parts in correct relationship; then remove eight screws (2) which attach cover to valve outer spider. Remove cover, diaphragm (23), diaphragm push plate (22), coupling lock (21), outer spring seat (20), spring (18) and spring inner seat (5) from valve.

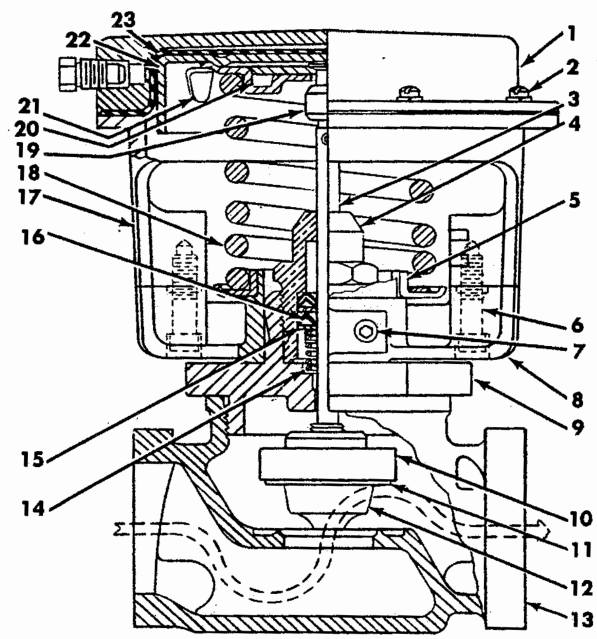
4. Remove two set-screws (7) which secure spider (8) to bonnet (9).

5. Outer spider (17) can be separated from inner spider (8) after removing two attaching screws (6).

6. Measure over-all length of stem assembly including stem button (19) and valve guide (12), to reassure adjustment to same length at time of assembly.

7. Using a nail in small hole of valve stem to hold stem from turning, thread stem button (19) from end of stem.

8. Unscrew packing nut (4) from bonnet (9); then slide packing nut with packing (16) from stem. Remove packing washer (15) and packing spring



1 Cover
2 Cover Screws
3 Valve Stem
4 Packing Nut
5 Spring Inner Seat
6 Screw
7 Set Screw
8 Inner Spider
9 Bonnet
10 Valve Holder
11 Valve Disc
12 Valve Guide
13 Valve Body
14 Packing Spring
15 Packing Washer
16 Packing Ring
17 Outer Spider
18 Return Spring
19 Stem Button
20 Spring Outer Seat
21 Coupling Lock
22 Push Plate
23 Diaphragm

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Figure 24—Water Modulation Valve

(14). Remove packing from packing nut.

9. Turn valve holder (10) valve disc (11) and valve guide (12) from end of stem.

ASSEMBLY

NOTE: Key numbers in text refer to figure 24.

1. Clean and inspect all parts before assembling valve. If any parts are damaged or worn; replace.

2. Assemble valve holder (10), valve disc (11) and valve guide (12) on end of valve stem (3) and tighten firmly.

3. Apply light silicone lubricant to packing rings and to interior of packing nut then insert stem through bonnet (9) and install packing spring (14), packing washer (15), one packing ring (16) another packing washer, remaining two packing rings (16), and packing nut (4) onto valve stem in sequence

mentioned. NOTE: Turn packing rings on valve stem threads with the spot of paint on each ring facing outward from valve body. Rings must be positioned as shown in figure 24. Screw packing nut into bonnet (9) and then tighten nut firmly.

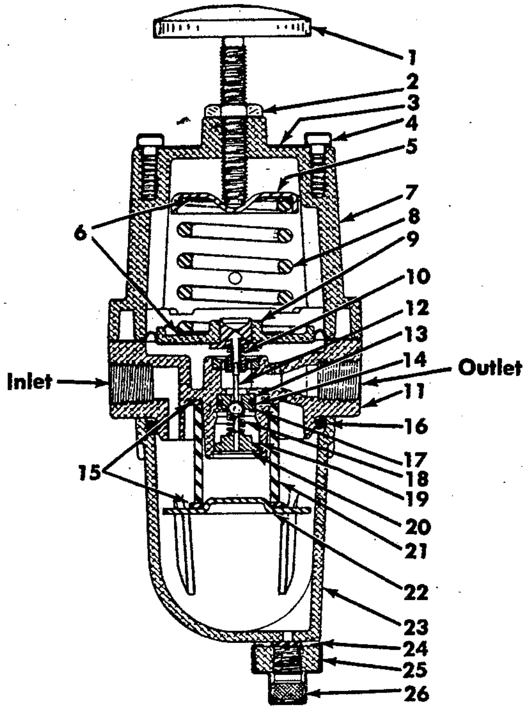
4. Thread stem button (19) on end of valve stem to a distance whereby over-all length of stem with stem button and valve guide equals measured length recorded prior to disassembly.

5. Attach outer spider (17) to inner spider (8) with two screws (6); then position spiders over bonnet (9) and secure with two set screws (7).

6. Position valve return spring inner seat (5), return spring (18), and spring outer seat (20) over valve stem in sequence mentioned; then compress spring and engage coupling lock (21) on end of stem.

7. Position diaphragm push plate (22) over outer spring seat; then position diaphragm (23) over push plate. While holding valve in closed position (compress stem return spring), install cover (1) over diaphragm and spider. Align marks on cover and spider made prior to disassembly and attach with eight cover screws (2). Tighten screws firmly.

8. Screw bonnet (9) and valve mechanism into valve body (13); then tighten bonnet firmly.



1 Adjusting Screw
2 Lock Nut
3 Name Plate
4 Screw
5 Spring Guide Plate
6 Spring Cushion (Cork)
7 Regulator Cover
8 Spring
9 Diaphragm Assy.
10 Bleed Spring
11 Valve Body and Diaphragm Assy.
12 Inner Valve
13 Seat
14 Seat Gasket
15 Filter Gasket
16 Body Gasket
17 Snap Ring
18 Inner Valve Spring
19 Valve Guide
20 Guide Snap Ring
21 Filter
22 Filter Seat
23 Bowl
24 Drain Screw Disc
25 Drain Screw Retainer
26 Drain Screw

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Figure 25—Air Pressure Regulator Valve

INSTALLATION OF MODULATION VALVE
(Refer to Fig. 15)

1. Arrow on valve body indicates direction of water flow through valve. Valve must be installed with arrow on valve body pointing toward heater core.

2. Position valve assembly with new flange gasket at each valve flange, up between water line inlet and outlet fittings and valve mounting brackets. Install four cap screws through valve mounting brackets, water inlet and outlet fittings, flange gaskets and thread into valve flanges. Tighten cap screws evenly and firmly.

3. Connect air supply line to cover of valve. Open air supply to valve, by turning regulator screw on pressure regulator valve, clockwise until pressure gauge at regulator valve indicates 10 lbs. pressure.

REPACKING VALVE

NOTE: Key numbers in text refer to figure 24.

1. Perform steps 1, 2, and 3 under "Removal of Modulation Valve."

2. Force the coupling lock (21) away from locked position with a screwdriver.

3. Loosen two spider set screws (7) then pull actuator unit (diaphragm, spring, and spiders) from valve bonnet.

4. Unthread stem button (19), exercising care not to disturb small set screw in end of stem button. Insert pin in small 1/16" hole just below stem button to hole stem while removing button.

IMPORTANT: Do not mar stem.

5. Thread packing nut (4) from bonnet (9). Remove spring (14) packing washers (15) and packing rings (16) from packing nut.

6. Clean and polish valve stem (3) if necessary with trichloroethylene and crocus cloth. Rub the stem lengthwise with cloth.

7. Dip the new packing rings in a light silicone lubricant and allow to drain. Also coat valve stem and inside of packing nut with lubricant.

8. In the following sequence, install packing spring (14) one steel packing washer (15), one packing ring (16), another packing washer (15) and remaining two packing rings on valve stem. NOTE:

Turn packing rings over stem threads, with the spot of paint on each ring facing outward from valve body.

9. Replace the stem button (19) on valve stem. Tighten button firmly. Do not disturb set screw in stem button.

10. Reinstall the actuator units as directed previously under "Assembly" of valve.

PRESSURE REGULATOR VALVE

Air pressure regulator valve (fig. 25) is mounted on forward wall of underfloor heating and cooling compartment (fig. 15) and is accessible through right forward baggage compartment and forward door to the heating and cooling compartment. Valve serves two purposes, to strain the air of dirt and moisture and to regulate air pressure to Grad-U-Stat. As the Grad-U-Stat uses the compressed air, the regulator valve admits additional compressed air, thus maintaining a constant pressure at Grad-U-Stat. Air pressure at Grad-U-Stat should be 10 lbs.

Should there be a constant bleeding of air through vent hole in the regulator cover (7, fig. 25), the inner valve assembly should be checked. Foreign matter may be lodged in valve seat, the valve may be worn.

ADJUSTMENT (Refer to Fig. 25)

When adjusting air pressure regulator valve, always observe air pressure reading on air pressure gauge at regulator valve outlet. To adjust valve, loosen lock nut at top of valve, unlocking valve adjusting screw. Turn adjusting screw counterclockwise to lower air pressure output. Adjusting screw in complete counterclockwise position will shut off air pressure entirely. To raise air pressure output, turn adjusting screw clockwise until desired air pressure output is indicated on air pressure gauge at valve. Air pressure gauge should be checked occasionally using test gauge to check accuracy of valve gauge.

DRAINING

Drain regulator valve at regular intervals to drain collected moisture by turning out drain screw (26, fig. 25) at bottom of valve.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 25.

1. Loosen lock nut (2) which secures adjusting screw (1) in regulator cover (7). Turn out adjusting screw from cover.

2. Scratch or mark side of regulator cover (7), valve body assembly (11) and bowl (23) to assure original alignment at assembly. Remove four screws attaching these units together.

3. Remove regulator cover (7), spring guide plate (5), cushion (6), spring (8), another cushion (6), diaphragm assembly (9), and small bleed spring (10) from valve body (11).

4. Separate valve body (11) from bowl (23). Remove body gasket (16) from valve body, then remove filter (21), filter gaskets (15) and filter seat (22) from filter body.

5. Inner valve (12), valve spring (18) and valve guide (19) can be removed from valve body after removing guide snap ring (20) from body.

6. Remove snap ring (17), then using a small hooked tool pull inner valve seat (13) with seat gasket (14) from valve body (11).

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 25.

1. Clean all parts except diaphragm (9) and valve body assembly (11) with cleaning solvent. Wipe diaphragm and valve body with clean cloth. Clean filter (21) using compressed air directed from inside of filter.

2. Make visual inspection of valve body (11) and bowl (23) for cracks and breakage. If diaphragm in valve body is cracked, it will be necessary to replace complete valve body and diaphragm assembly.

3. Replace springs indicating evidence of corrosion, fracture, or weakness.

ASSEMBLY

NOTE: Key numbers in text refer to figure 25.

1. Position drain screw disc (24) in bowl then install drain screw (26). Install drain screw retainer (25) over drain screw to body.

2. Lower filter seat (22) with rubber gasket (15), filter (21) and another gasket (15) into bowl (23).

3. Place seat gasket (14) into groove of valve seat (13). Press seat with gasket into valve body and install retaining snap ring (17). Refer to illustration for position of parts.

4. Position body O-ring gasket (16) over shoulder of valve body (11).

5. Insert inner valve (12), valve spring (18) and valve guide (19) in valve body and retain with guide snap ring (20). Refer to illustration for proper positioning of parts.

6. Lower valve body assembly over filter to bowl.

7. At top of valve body, position small bleed spring (10) over protruding needle point.

8. Position diaphragm (9) to valve body making sure center of diaphragm engages valve needle in valve body. NOTE: Top side of diaphragm has lipped-seat for engaging main spring (8).

9. Install main spring cushion (6) in spring seat of diaphragm, then install main spring (8),

another cushion (6) and spring guide plate (5).

10. Lower regulator cover (7) down over spring to valve body. Align marks made prior to disassembly on bowl, valve body, and regulator cover. Make sure screw holes in diaphragm are also aligned. Install four screws attaching units together. Tighten screws evenly and firmly.

11. Thread lock nut (2) and adjusting screw (1), then thread adjusting screw into regulator cover. Adjust regulator as directed previously under "Adjustment."

UNDERFLOOR HEATER COMPARTMENT

Underfloor heater compartment is located under coach floor at rear of front axle (fig. 15). Access to compartment being through right forward baggage compartment door and through two wooden inner compartment doors. Right and left inner doors are hinged while center partition is attached to opening with screws and washers.

Heater compartment is air tight, made so by use of seals at doors and at wiring and lines entering compartment. Water drains and traps in floor under forward area of compartment allows moisture collected on air conditioning evaporator to drain from compartment, and are so designed to eliminate air from entering compartment. Compartment units consists of air pressure regulator valve, air filter, air conditioning evaporator, heater core and blower unit.

UNDERFLOOR AIR FILTER

Air filter, mounted at forward end of heating and cooling compartment (fig. 15), filters all air passing through compartment and is accessible after opening forward compartment door. Filter is easily removed from compartment by pulling from slide channels.

Clogged filter restricts air circulation, thus reducing efficiency of system. In addition to the effect on system operation, dirty filter will permit dirt to pass into the evaporator and heater core clogging coils and fins.

Air filter is of all metal construction and should be removed frequently and thoroughly washed. Filter should then be sprayed sparingly with odorless oil, or dipped and thoroughly drained.

AIR FILTER MUST BE KEPT CLEAN FOR SATISFACTORY OPERATION OF HEATING, COOLING AND VENTILATING SYSTEMS.

Install air filter in slide channels with coarse screened surface of filter (if one side is coarser than other) facing front of coach.

UNDERFLOOR HEATER CORE

The heater core located between blower and air conditioning evaporator is of fin and tube design, similar to a conventional radiator. Core can be repaired in same manner as a conventional radiator.

<u>Removal of Heater Core</u>

1. Drain heating system as previously explained under "Maintenance."

2. Remove water modulation valve and mounting brackets from right forward baggage compartment. Refer to "Removal of Water Modulation Valve" explained previously.

3. Remove center partition from heating and cooling compartment by removing screws and washers.

4. Disconnect heater supply and return pipe connection hoses by removing hose clamps. Remove heater core supply pipe from support bracket and grommet at top of compartment.

5. Remove screws which attach heater core shroud cover and seal to blower housing. From underneath coach, remove two hex head bolts which attach heater core to compartment floor. Carefully pull heater core with shroud from compartment.

<u>Installation of Heater Core</u>

1. Position heater core with shroud assembled in heating compartment, making sure shroud engages blower housing properly. Apply a coating of suitable rust preventive compound to threads of core mounting bolts; then from underneath coach install mounting bolts. Tighten bolts firmly. Install four screws attaching heater core shroud cover and seal to blower housing.

2. Install heater core supply pipe through grommet and pipe support bracket at top of compartment. Connect water supply and return pipe hoses to heater core with hose clamps. Tighten hose clamp screws firmly.

3. Install heating compartment center wooden partition to compartment with screws and washers.

4. Install water modulation valve mounting brackets to top of baggage compartment; then install water modulation valve as directed previously under "Installation of Modulation Valve."

5. Refill heating system.

UNDERFLOOR BLOWER MOTOR

Blower motor rotates clockwise as viewed from motor pulley end, and is swivel mounted on underfloor blower assembly (fig. 15). Motor being swivel mounted, allows for blower drive belt replacement and belt adjustment.

Motor is of the double circuit two-speed type. Low-speed circuit is used when operating heating system, and high-speed circuit when operating cooling system. Either the high-speed or low-speed circuit can be used in conjunction with ventilation system at discretion of operator. Blower motor

control switch is located on control panel at left of driver. Placing control switch in "HEATING" position energizes low-speed magnetic switch located in right forward baggage compartment (fig. 9, Sec. 7), which in turn energizes low-speed circuit to motor. Placing control switch in "COOLING" position energizes high-speed magnetic switch in same compartment, which in turn energizes high-speed circuit to motor. Blower motor circuits are protected by circuit breakers which are also located in right forward baggage compartment. Refer to "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7).

Removal of Blower Motor

1. Position "HEATING" and "COOLING" control switch on control panel at left side of driver in "OFF" position.

2. Remove rear wooden door with hinge assembly from heating and cooling compartment to provide necessary clearance.

3. Disconnect wiring harness at blower motor terminals.

4. Remove cap screw which attaches blower motor adjusting arm to motor, then push in on motor and remove blower drive belt. With motor in this position, remove two accessible cap screws which attach motor to motor swivel bracket. Swing motor outward and down; then remove two remaining cap screws attaching motor to bracket. Remove motor.

Installation of Blower Motor

1. Install blower motor on blower assembly in reverse procedure to step 4, explained previously under "Removal of Blower Motor." CAUTION: Do not use bolts longer than 3/4 inch to attach bracket to motor, otherwise damage to motor will result.

NOTE: Adjust blower belt to tension that belt is not too loose causing belt slippage, or so tight that excessive strain is placed on blower shaft and motor bearings.

2. Connect wiring harness to blower motor terminals.

3. Install heating and cooling compartment left door.

UNDERFLOOR BLOWER

Blower rotates clockwise, as viewed from pulley end, drawing air from outside and interior of coach through air inlet ducts. Air is drawn through air filter, air conditioning evaporator and heater core. After air passes through blower it is then forced into air outlet ducts and distributed through-out coach.

Blower is belt driven by motor which is swivel mounted on blower housing. Belt tension can be adjusted after loosening cap screw which attaches adjusting arm to motor. Blower shaft bearings can be lubricated from two exposed fittings after opening compartment rear door. Refer to LUBRICATION (SEC. 13).

Removal of Blower

1. Remove blower motor as previously directed under "Removal of Blower Motor."

2. Remove protector cover from water modulation valve and from circuit breakers and magnetic switches located in right forward baggage compartment to permit necessary clearance for blower removal.

3. Remove four screws which attach blower-to-shroud cover and seal to heater core shroud. Remove cover and seal.

4. From underneath coach, remove four bolts which attach blower assembly to compartment floor; then carefully pull blower assembly from compartment.

Installation of Blower

1. Inspect blower housing seals and replace if necessary.

2. Position blower assembly in heating and cooling compartment. Apply a coating of suitable rust preventive compound to threads of blower mounting bolts; then from underneath coach install mounting bolts. Tighten bolts snug only.

3. Install blower-to-shroud cover and seal to heater core shroud. Final tighten blower mounting bolts.

4. Install blower motor as previously directed under "Installation of Blower Motor."

5. Install protector covers over water modulation valve and over circuit breakers and magnetic switches in right forward baggage compartment.

DEFROSTER HEATER

Defroster heater unit, consisting of a heater core and two motors with individual blowers is installed in dash compartment, front of dash center closure panel (fig. 26). Air is distributed by blowers to six defroster air outlets through four flexible air ducts. Air can also be deflected toward driver's feet through damper controlled outlet. Outlet damper is manual controlled.

Slotted head bleeder plug is located at left-upper corner of heater core. Flow of water through heater core is controlled by regulator valve installed in heater core supply line.

Regulator valve control knob is mounted on side of heater compartment at right of driver. Regulator valve capillary tube samples air in compartment under heater assembly, causing valve to modulate flow of water, maintaining a desired temperature.

Manual adjustment of regulator valve is provided by a knob installed on valve shaft. Turning knob clockwise raises regulator setting, and complete clockwise rotation holds valve fully open re-

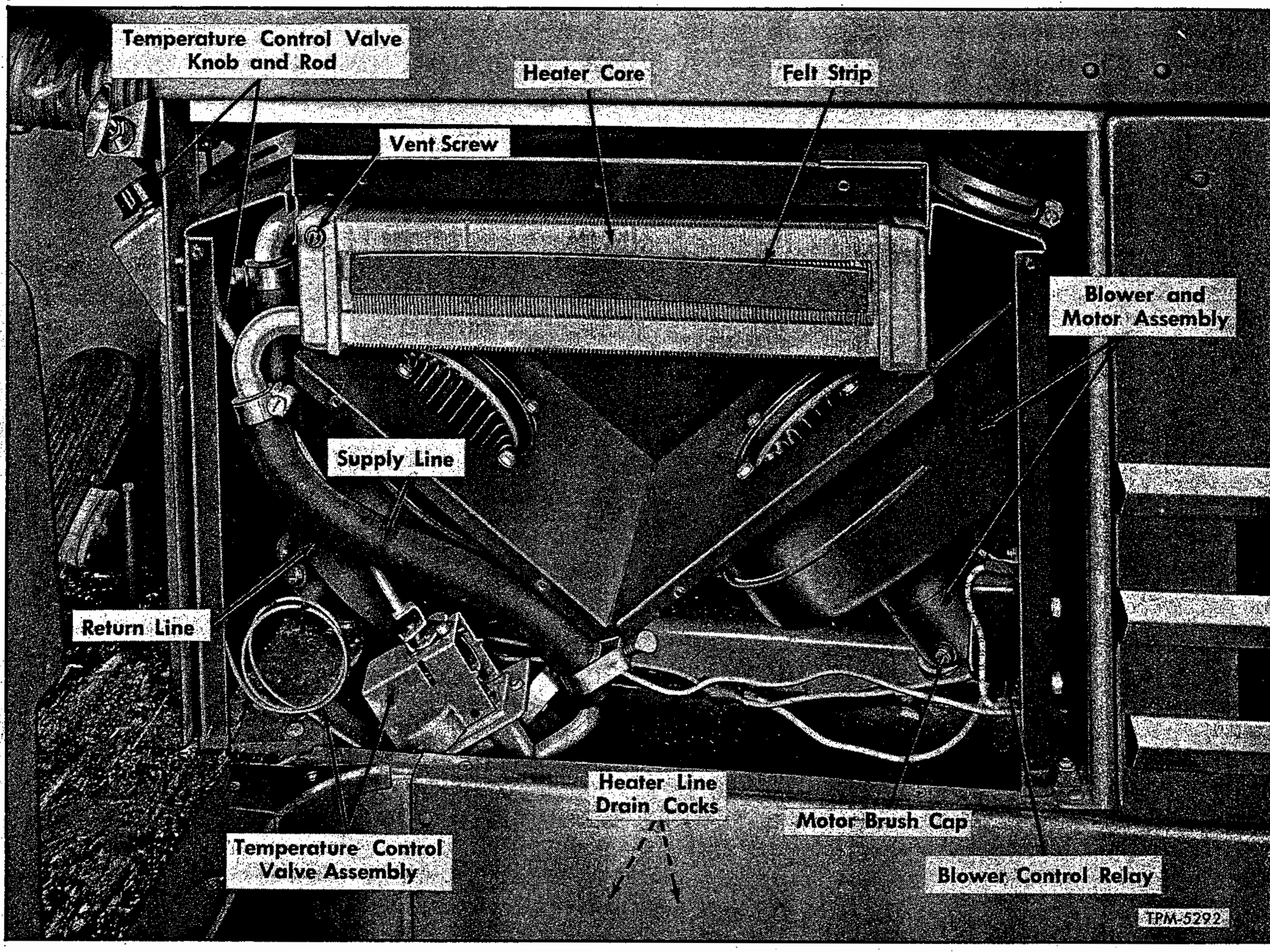


Figure 26—Defroster Heater and Control Installed

gardless of coach temperature. Turning knob counterclockwise lowers regulator setting, and complete counterclockwise rotation holds valve closed, regardless of coach temperature.

Air drawn through heater core may be all recirculated air, taken in through dash compartment opening, or part outside air taken in through heater ventilator intake. Heater ventilator intake may be opened or closed by driver, by operating damper control lever, located under dash panel at left of heater.

Defroster heater blowers and motors are mounted at underside of heater. Motors require no maintenance, and should operate indefinitely without attention. In the event of failure, motors can be disassembled, brushes replaced, and commutators turned and undercut in accordance with established practice. Whenever motor is disassembled, bearings should be lubricated at assembly. Defroster blowers are controlled by a two-speed "DEFROST" - "HI" and "LO" switch located on control panel at right of driver. Defroster motor circuit is protected by number 14 circuit breaker on circuit breaker panel, which is located at left of driver. Circuits to defroster blower motors are equipped with a relay mounted at underside of heater. Refer to "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7).

Heater core, blowers, blower motors, motor relay, temperature regulator valve, water pipe connections and water drain cocks are accessible after removing dash center closure panel which is attached to front end with three hex-head cap screws and three cross-recessed screws.

Heater core can be removed from unit after draining system, removing heater unit panel, and disconnecting core hoses.

VENTILATION

Outside air is admitted to coach interior, through various window openings and through a screened intake in front panel located in front of defroster heater. Amount of outside air entering heater is manually controlled by operator. Pushing of damper lever located at right of operator under

dash ledge, forward will open air intake and pulling rearward on lever will close intake.

Refer to "DEFROSTER HEATER" described previously for operation of blowers and motors which are used in conjunction with ventilation at front of coach.

Outside air is also drawn into interior of coach by the underfloor blower, through a perforated opening in each side of body below forward side windows. Air is then forced into ducts and distributed throughout coach. Amount of outside air admitted is controlled by the positioning of damper control rod located under each recirculated air inlet under seats. Damper control rods are accessible from aisle by reaching under seats.

If ventilation is desired without cooling system in operation, place control switch in air conditioning engine compartment in "SAFETY" position and place "MASTER SWITCH" on control panel at left of driver in "COOLING" position.

On coaches not equipped with air conditioning place control switch at left of operator in "VENTILATION" position.

HEATING SYSTEM TROUBLE SHOOTING GUIDE

TROUBLE	POSSIBLE CAUSES
UNDER-HEATING (Items with an asterisk (*) also apply to under-cooling)	Grad-U-Stat setting too low *Grad-U-Stat out of calibration *Grad-U-Stat valve unit sticking or damaged *Water modulating valve stem bent or sticking *Foreign material in water modulating valve body *Blower inoperative *Air filter dirty Heater core dirty *Proportion of outside air admitted too high *Clogged recirculated air inlet screen Defective air duct outlet thermostats Heater line gate valves closed Air in heater system water lines UNDER-COOLING ONLY: Grad-U-Stat setting too high. Pressure regulator valve setting too low. Leakage in air lines and fittings.
OVER-HEATING (Items with an asterisk (*) also apply to over-cooling)	Grad-U-Stat setting too high *Grad-U-Stat out of calibration *Grad-U-Stat valve unit sticking or damaged Pressure regulator valve setting too low Leakage in air lines and fittings. Defective diaphragm in water valve. Proportion of outside air admitted too low OVER-COOLING: Grad-U-Stat setting too low.
ALTERNATE UNDER- AND OVER-HEATING	Water modulating valve stem bent or sticking Throttling range setting of Grad-U-Stat too low (also applies to alternate over- and under-cooling)
NOTE: Throttling range setting of $6^{o}F$ is recommended for Grad-U-Stat.	

Lavatory

DESCRIPTION

Lavatory and toilet facilities are provided for passenger comfort and convenience (fig. 27). Lavatory is located at right rear corner of coach. Lavatory compartment is equipped with wash basin, chemical toilet, liquid soap dispenser, mirror, waste paper container, toilet tissue dispenser, paper towel dispenser, sanitary napkin dispenser and ash tray for passenger requirements, convenience and comfort. Figure 28 illustrates schematic view of lavatory.

Window in lavatory is frosted, thus assuring maximum privacy. An electric motor driven blower shown in figure 29 is used to exhaust objectionable odors from lavatory compartment. Another electric motor driven water pump, located on floor in front of lavatory transverse partition (fig. 30), supplies water to wash basin from a 17 gallon water tank also located front of lavatory compartment. A permanently installed 14 gallon chemical waste tank is located directly below lavatory compartment. Tank has facilities for emptying beneath the coach (fig. 34), thus eliminating the possibility of odors entering coach.

OPERATION

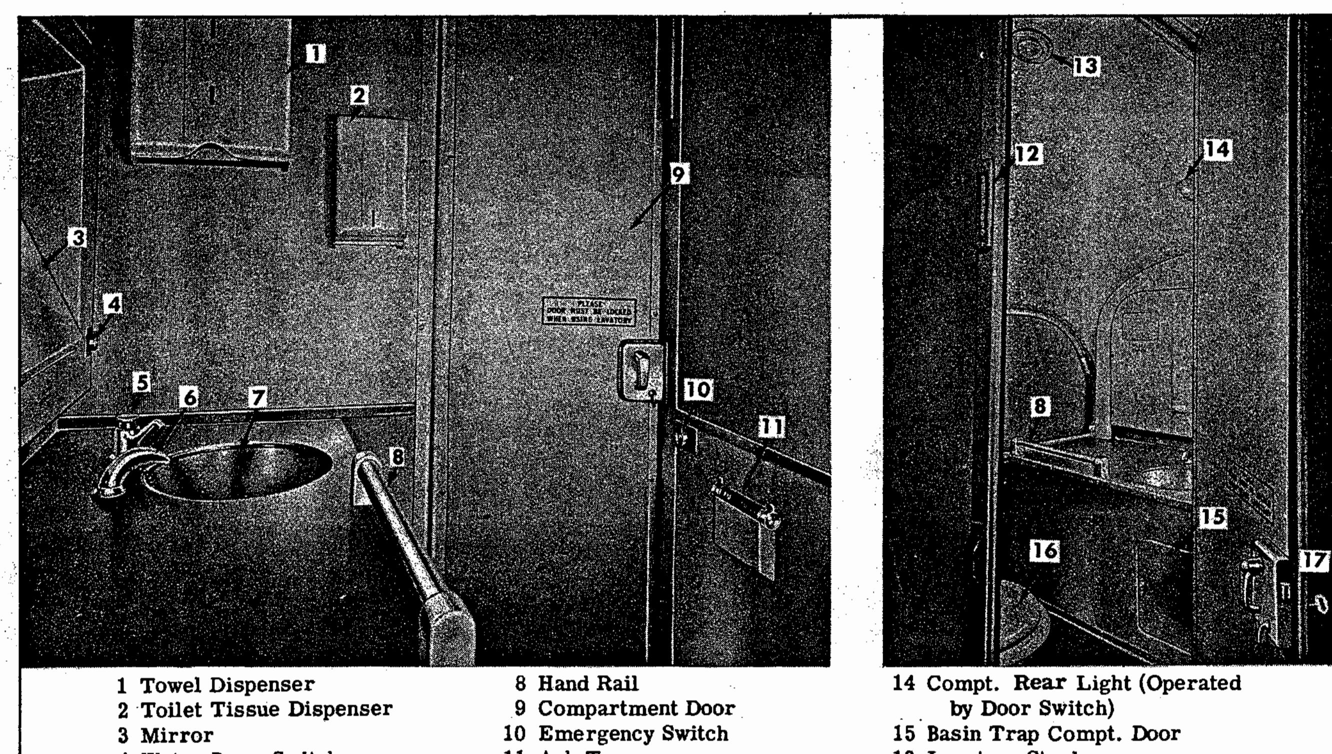
Whenever possible, automatic controls are provided for maximum passenger safety, comfort and privacy. Following information describes purpose and function of individual units.

VENTILATOR BLOWER

Ventilator blower, mounted in toilet seat riser compartment as shown in figure 29, forces objectionable odors from the lavatory compartment to outside of coach.

Blower on some coaches operates at high speed whenever the engine control switch is placed in "RUN" position (See Wiring Diagram MD-84004).

On other coaches, blower operates at reduced speed whenever engine control switch is placed in "RUN" position; circuit to blower motor on these



1 Towel Dispenser
2 Toilet Tissue Dispenser
3 Mirror
4 Water Pump Switch
5 Soap Dispenser
6 Basin Spout
7 Wash Basin
8 Hand Rail
9 Compartment Door
10 Emergency Switch
11 Ash Tray
12 Wash Room Sign
13 Compt. Front Light (Operated by Marker Light Switch)
14 Compt. Rear Light (Operated by Door Switch)
15 Basin Trap Compt. Door
16 Lavatory Stool
17 Lavatory Key

TPM-5286

Figure 27—General Arrangement of Lavatory

coaches is fed through a resistor to provide low speed operation of blower. Whenever lavatory door is closed and locked from inside compartment the blower motor will operate at high speed. High speed circuit is energized by lavatory door inside latch switch and the blower relay.

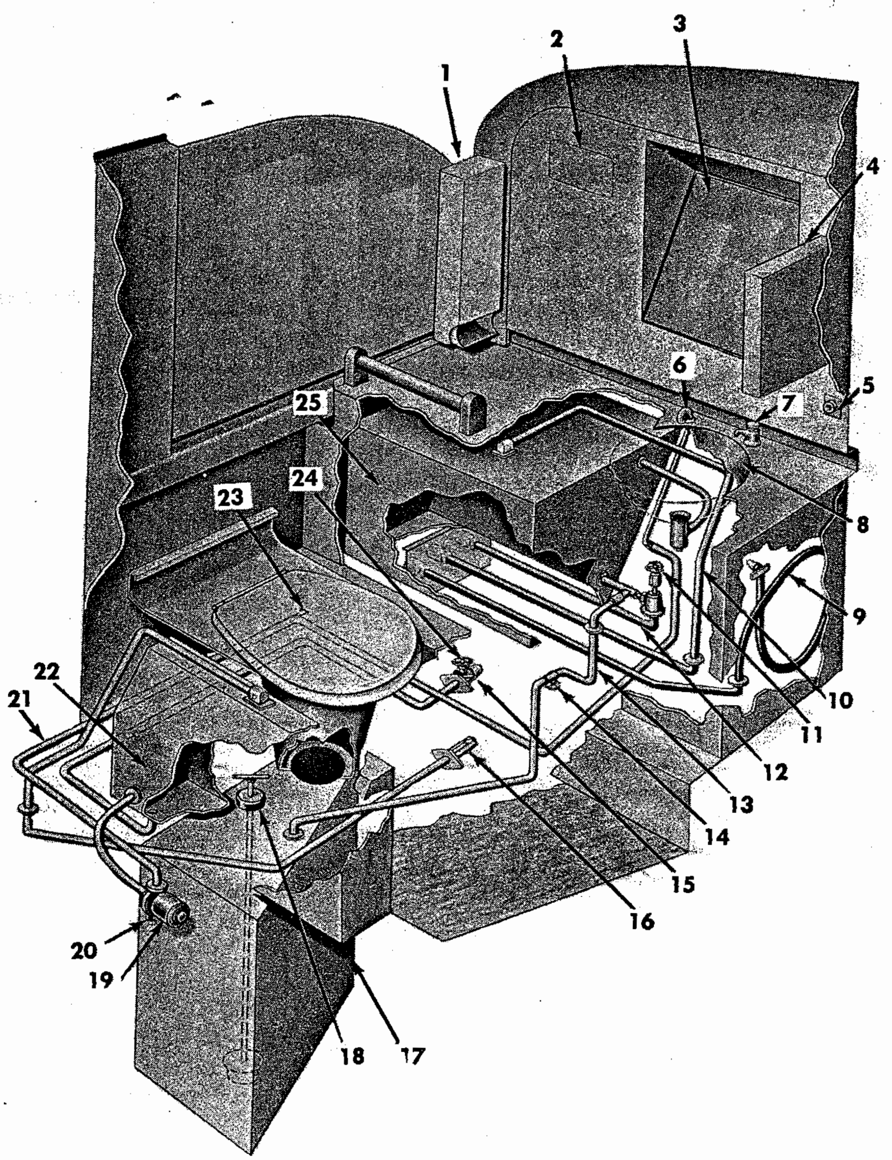
A 6-amp line fuse is installed in blower motor feed wire near the control relay. Refer to relays in ELECTRICAL (SEC. 7) for description of lavatory control relay and the blower relay. Blower control circuits are shown on Lavatory Wiring Diagrams MD-83294 and MD-84004 in back of manual.

BLOWER RELAY

Blower relay (when used) controls the speed of the lavatory blower motor and is located on relay and limit switch panel as shown in figure 7 in ELECTRICAL (SEC. 7). Purpose of relay is to provide a circuit which bypasses the resistor in the ventilator blower motor circuit and runs the blower motor at high speed when lavatory is occupied. Circuit through relay is explained under "Relays" in ELECTRICAL (SEC. 7). Refer to Lavatory Wiring Diagram (MD-83294).

LAVATORY CONTROL RELAY

Lavatory control relay which controls circuit



1 Sanitary Napkin Dispenser
2 Waste Paper Container
3 Mirror
4 Paper Towel Dispenser
5 Water Pump Switch
6 Basin Spout
7 Soap Dispenser
8 Wash Basin
9 Toilet Stool Flushing Hose
10 Wash Basin Drain Tank Flushing Line
11 Wash Basin Drain Tank to Side Fitting Line Valve
12 Wash Basin Drain Tank to Side Fitting Line
13 Wash Basin Drain Tank to Chemical Tank Line
14 Wash Basin Drain Tank to Chemical Tank Line Valve
15 Water Supply Tank Fitting and Draining Fitting
16 Water Supply Tank Flushing Fitting
17 Chemical Tank
18 Chemical Tank Drain Plug Rod
19 Water Pump and Motor
20 Water Pump Drain Cock
21 Water Pump to Basin Line
22 Water Supply Tank
23 Wash Basin Supply Line Drain Valve
24 Supply Tank Filling and Draining Valve
25 Wash Basin Drain Tank

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Figure 28—Schematic of Lavatory

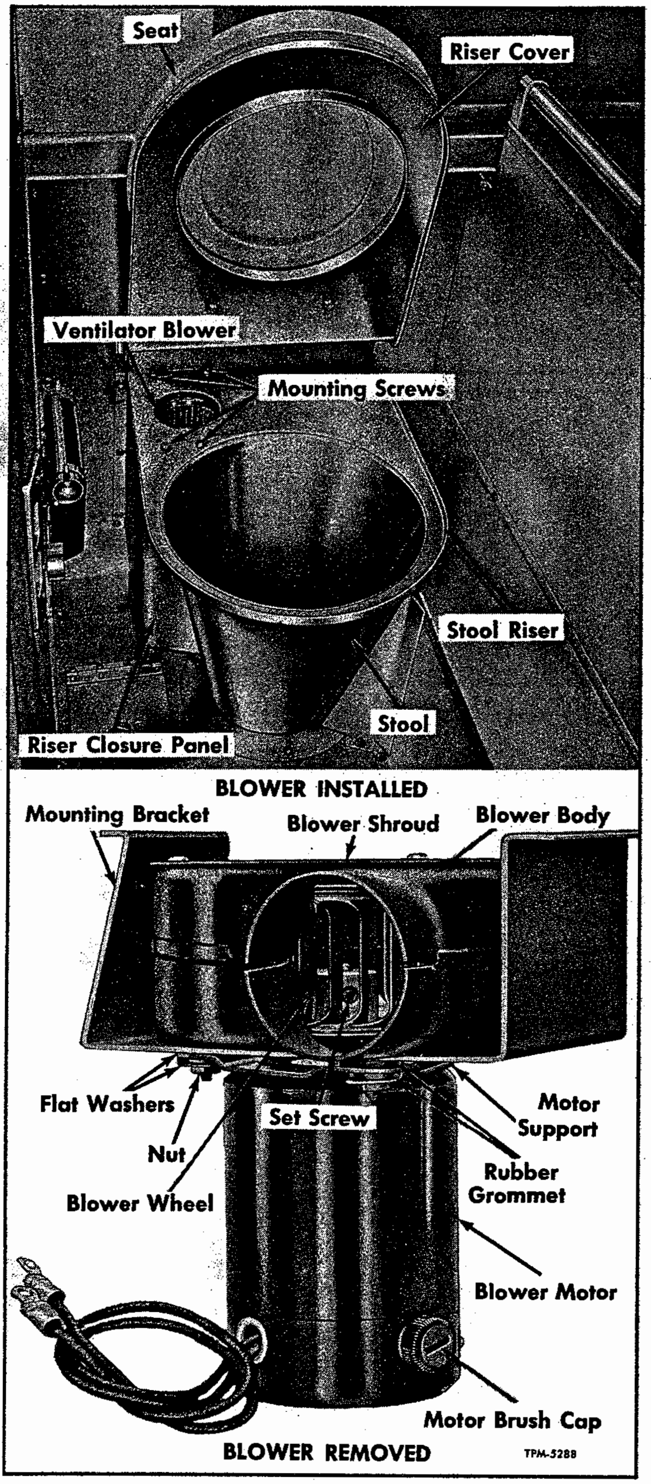


Figure 29—Lavatory Ventilator Blower

to lavatory lights and units when the engine control switch is placed in "RUN" position is located in electrical compartment as shown in figure 7, in ELECTRICAL (SEC. 7). Circuit through relay is explained under "Relays" in electrical section. Refer to applicable Lavatory Wiring Diagram (MD-83294 and MD-84004) in back of manual for relay circuits.

WASH BASIN SUPPLY PUMP

Electrically operated water pump shown in figure 30 located at rear of last seat on right side of coach, supplies water to the wash basin when required. Pump operates when water pump switch button shown in figure 27 is pressed in. A check valve mounted in basin supply line above water pump retains water in line when water pump is not operating. Electrical circuit to water pump motor is explained later under "Basin Water Pump Switch" and "Basin Water Pump Limit Switch."

BASIN WATER PUMP SWITCH

Water pump switch marked "PUSH FOR WATER" is located in the lavatory compartment as shown in figure 27. By pressing switch button, circuit is completed to water pump limit switch and to water pump motor. For circuit continuity, refer to applicable Lavatory Wiring Diagram (MD-83294 or MD-84004) in back of manual.

BASIN WATER PUMP LIMIT SWITCH

Water pump limit switch is mounted in electrical compartment as shown in figure 7 in ELECTRICAL (SEC. 7). Limit switch is connected in series with water pump motor circuit. When water pump switch button is pressed in, water will flow into wash basin for approximately 15 seconds, then limit switch will break pump circuit and water will cease to flow. After waiting approximately 18 seconds, limit switch element will cool and contacts within switch will close, and again complete circuit to pump motor. For circuit continuity, refer to applicable Lavatory Wiring Diagram (MD-83294 or MD-84004).

LAVATORY EMERGENCY BUZZER

Lavatory emergency buzzer is mounted on panel under dash in front of driver as shown in figure 10 in ELECTRICAL (SEC. 7). Buzzer is operated by push-button type switch marked "TO SIGNAL DRIVER - EMERGENCY ONLY" is located on transverse partition of lavatory compartment (fig. 27). To check circuit continuity, refer to applicable Lavatory Wiring Diagram (MD-83294 or MD-84004) in back of manual. If buzzer becomes defective, it must be replaced.

EMERGENCY BUZZER SWITCH

Emergency buzzer switch marked "TO SIGNAL DRIVER - EMERGENCY ONLY" is located on transverse partition of lavatory compartment as shown in figure 27.

DOME LIGHTS

Two dome lights are mounted in ceiling of lavatory (fig. 27). Forward light is connected in

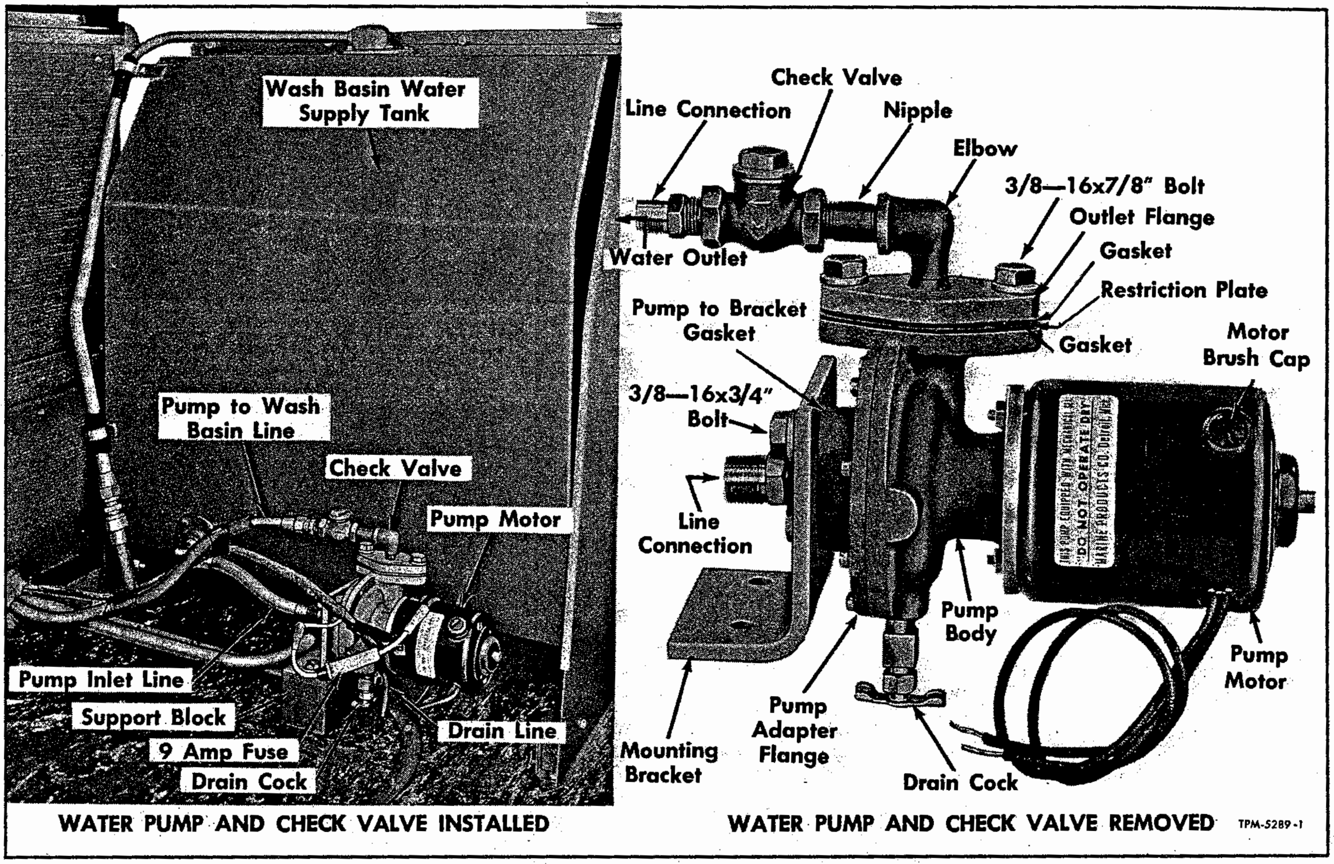


Figure 30—Water Pump and Check Valve

coach marker light circuit and is illuminated whenever marker lights are turned on. Lamp mounted in ceiling over mirror is illuminated only when lavatory is occupied and door is closed and locked. For circuit continuity, refer to applicable Lavatory Wiring Diagram (MD-83294 or MD-84004) at back of manual.

LAVATORY SIGN LIGHT

Lavatory sign light (fig. 27) located on transverse partition of compartment is illuminated when lavatory is occupied, door closed, and locked. Sign reads "WASH ROOM OCCUPIED."

LAVATORY DOOR LOCK

Door lock, installed on lavatory door, has inside and outside latch handles to open and close door as shown in figure 31. Lift up on latch when entering lavatory. In addition, inside of lock is fitted with a locking lever, which forces latch bolt outward to operate a switch in transverse partition. If locking lever fails to release, door can be opened from outside by a special key furnished to driver.

DOOR LOCK SWITCH

Door lock switch is "Micro" type and is installed in edge of transverse partition as shown in figure 31. Switch is closed by outward movement of door lock bolt when door is locked from inside compartment. Closing of lock switch completes electrical circuit to lavatory 21 C.P. light, washroom occupied sign light, and on some coaches it energizes blower relay to operate ventilation blower motor at high speed. For circuit continuity, refer to applicable Lavatory Wiring Diagram MD-83294 or MD-84004) in back of manual.

MAINTENANCE

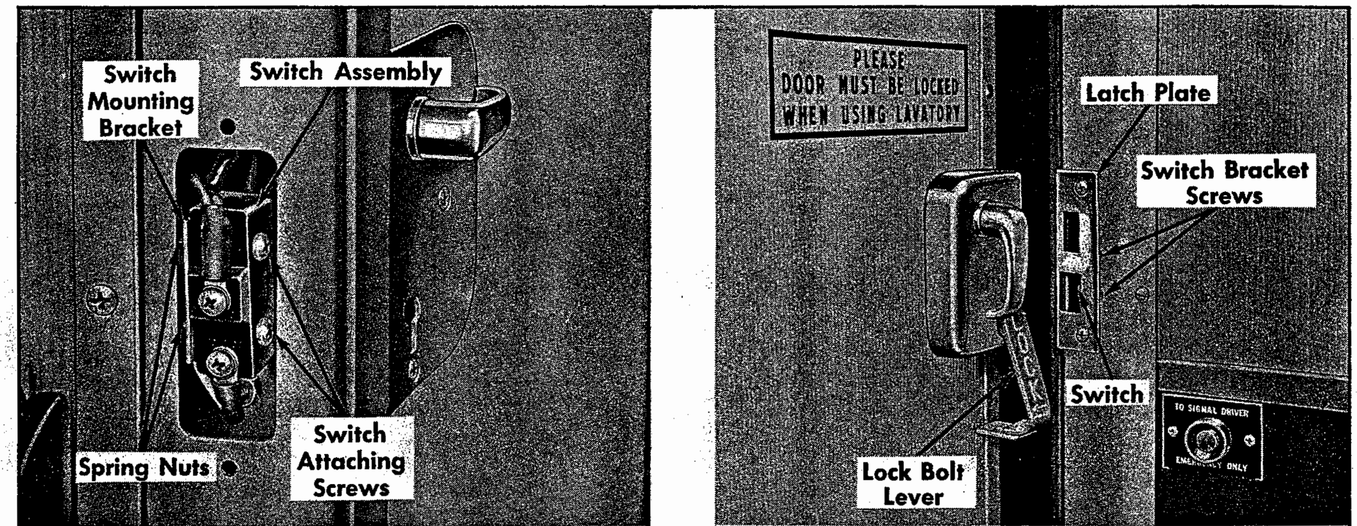
GENERAL

All lavatory filling, draining, and flushing service lines are accessible after opening right rear side closure door (fig. 32). Ends of lines are equipped with quick release coupling fittings to which a flexible service hose with a mating coupling (fig. 33) can be attached for servicing tanks.

Hose coupling, which is of the Hansen 6000 Series, can be obtained at your local Hansen dealer or can be ordered from the Hansen Mfg. Co., 4031 West 150th St., Cleveland, Ohio.

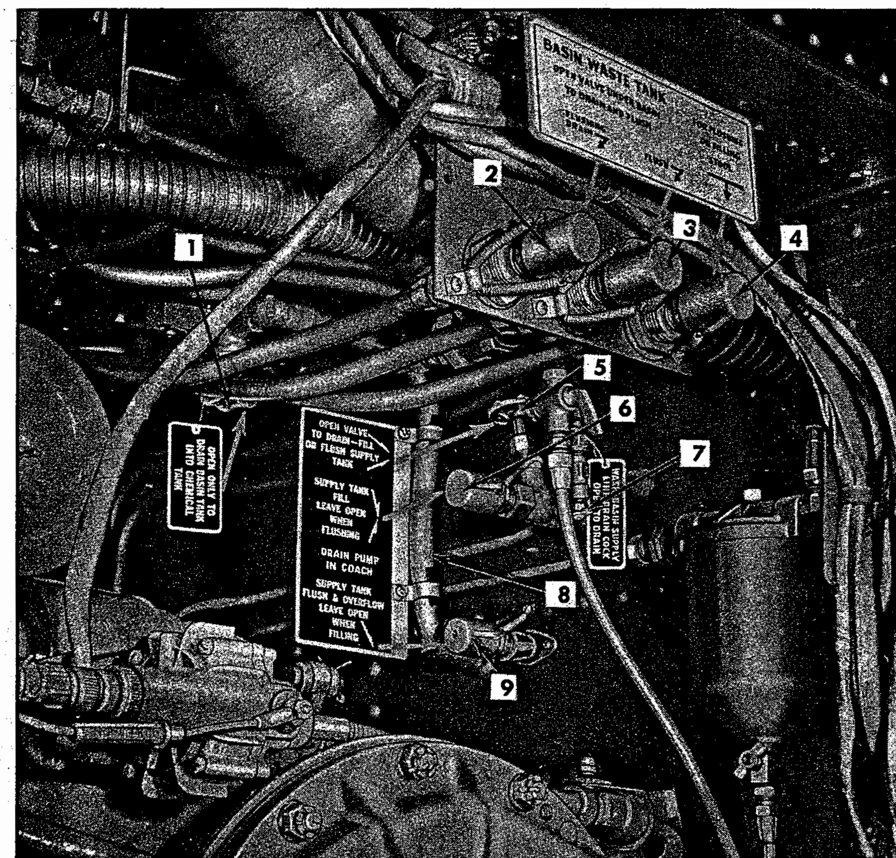
Coupling hose can usually be purchased locally or can be ordered from the Gates Rubber Company, Denver, Colorado.

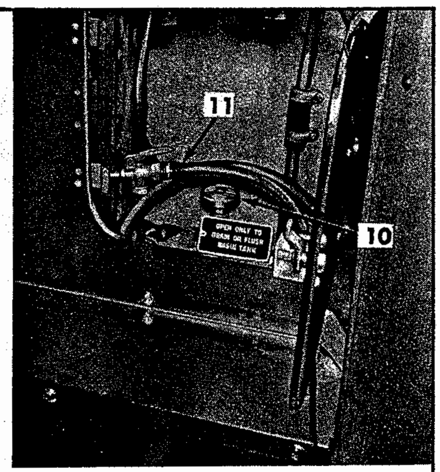
LAVATORY



OUTSIDE VIEW (SWITCH PLATE REMOVED) INSIDE VIEW TPM-5290

Figure 31—Door Lock and Switch (Typical)





WASH BASIN DRAIN TRAP COMPARTMENT

1 Wash Basin Drain Valve to Chemical Tank
2 To Wash Basin Drain Tank (For Reverse Flushing or Draining)
3 To Wash Basin Drain Tank (For Flushing)
4 To Flexible Hose for Flushing and Filling Chemical Tank
5 Wash Water Supply and Drain Valve - Closed in Service - Open to Fill or Drain
6 To Wash Water Supply Tank (For Filling or Draining)
7 Wash Basin Supply Line Drain Cock
8 Wash Basin Drain Line to Chemical Tank
9 Wash Basin Tank Overflow and Flush Line Fitting
10 Wash Basin Drain Tank Valve to Side Fitting
11 Stool Flushing Hose TPM-5291

Figure 32—Lavatory Service Valves and Fittings

Three valves are used when servicing lavatory; the wash water supply and drain valve (5, fig. 32), the wash basin drain valve to chemical tank (1, fig. 32) and the wash basin drain tank valve (10, fig. 32) to side drain and reverse flushing fitting

For the purpose of draining the chemical tank, special connectors and fittings shown in figures 34 and 35 are available from the Service Department, General Motors Truck and Coach, Pontiac, Michigan.

WASH BASIN SUPPLY TANK

Filling Supply Tank

1. In engine compartment, remove cover from water supply and drain fitting (6, fig. 32). Connect water supply hose to fitting, then open supply tank supply and draining shut-off valve (5, fig. 32).
2. Remove cover from supply tank overflow and flush line fitting (9, fig. 32), then fill supply tank with fresh water until water flows out overflow fitting.
3. After filling tank, close valve (5, fig. 32), remove supply hose, then replace protector covers on fittings (6, and 9, fig. 32).

Draining Water Supply Tank

1. In engine compartment, remove protector cover from fitting (6, fig. 32), then connect drain hose to fitting.
2. Open supply tank drain and filling valve (5, fig. 32) which will allow water to drain into sewer opening or receptical.
3. If tank is to be flushed, leave hose attached to fitting and leave valve open; otherwise close valve, disconnect drain hose and install protector cover over drain fitting.

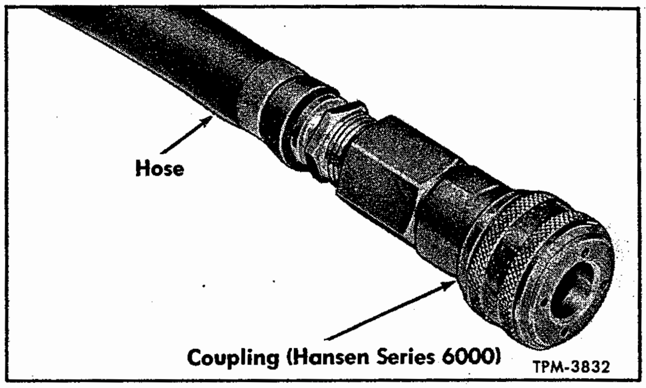


Figure 33—Hose and Coupling (Hansen Series 6000)

Flushing Supply Tank

1. In engine compartment, remove protector covers from fittings (6 and 9, fig. 32).
2. Connect drain hose to fitting (6, fig. 32) and connect water supply hose for flushing to fitting (9, fig. 32).
3. Open supply tank drain and filling valve (5, fig. 32) which will allow water to drain out hose into sewer opening or receptical.
4. Turn on water supply. Water is forced into top of supply tank through a shower-head type spray nozzle, flushing out tank.
5. After flushing tank, disconnect service hoses. Leave filling and drain valve (5, fig. 32) open until tank is filled.

LAVATORY CHEMICAL TANK

Draining Chemical Tank

1. Place coach over sewer opening and attach drain hose special quick-lock connector to tank outlet (figs. 34 and 35). If receptical or sewer facilities are not available, comply with local

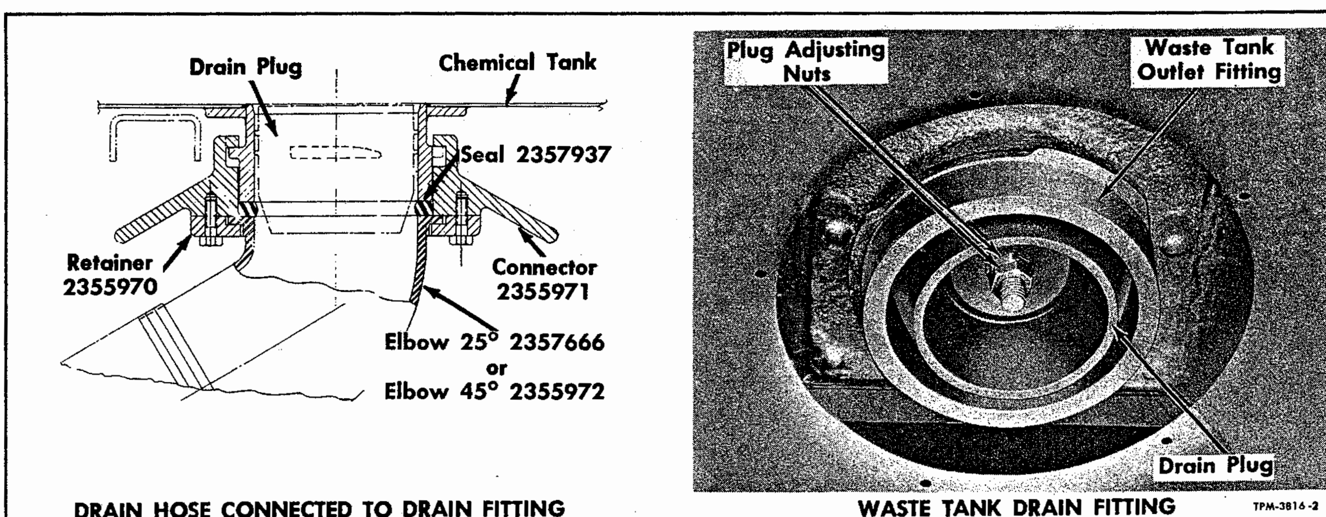


Figure 34—Chemical Tank Outlet and Quick-Lock Connector

health regulations.

2. On the floor of lavatory compartment, unlock and open the chemical tank drain plug handle cover (fig. 36). Pull handle up approximately six inches as shown; this action lifts large rubber drain plug (fig. 34) from opening in bottom of tank and permits tank to empty.

3. Leave drain plug out of tank drain opening until flushing operation or the draining of wash basin retention tank is completed.

Flushing Chemical Tank

1. In engine compartment, remove protector cover from fitting (4, fig. 32), then connect water supply service hose to fitting. Open water pressure into fitting.

2. Within lavatory, in small compartment under wash basin is located a flexible hose (11, fig. 32) with a valve-type nozzle. With this hose, direct water spray into toilet stool and chemical tank until flushing is completed.

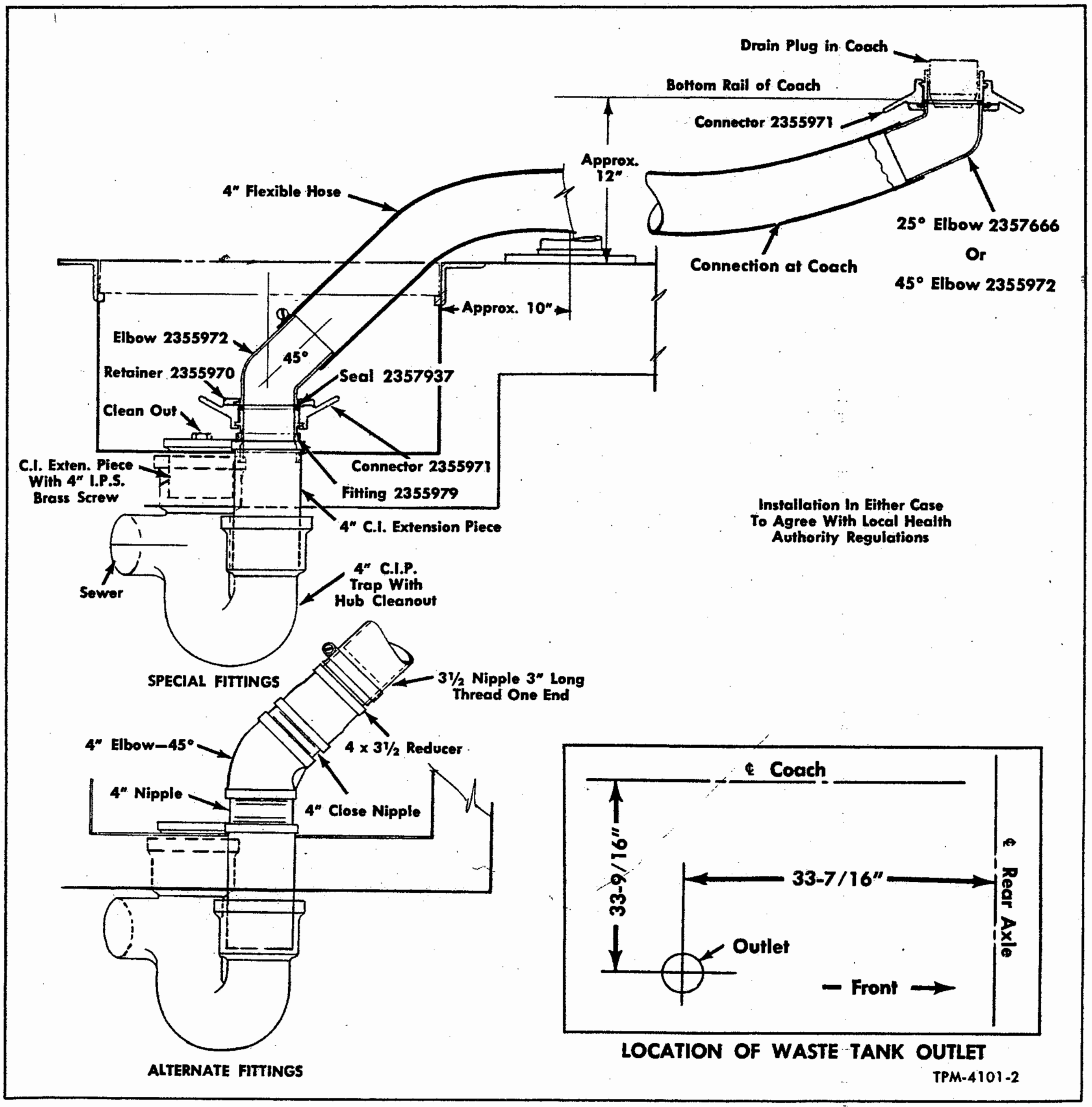


Figure 35—Typical Waste Tank Drain Connections

3. Leave water supply service hose connected until after tank is chemically treated.

Sealing Chemical Tank

1. Press chemical tank drain plug handle (fig. 36) down until handle rod upper seal is seated firmly to top of tank. This action will position drain plug (fig. 34) into tank drain opening. Close handle cover and lock.

2. Underneath coach, disconnect tank drain hose (fig. 34) (if used).

3. If tank drain plug does not seal satisfactory, expand plug diameter as directed under "Chemical Tank Drain Plug Adjustment."

Chemical Tank Drain Plug Adjustment

Adjustment is made underneath coach at lower end of drain plug (fig. 34).

1. To prevent drain plug rod from turning while making adjustment, have assistant hold the drain plug handle in lavatory compartment.

2. Underneath drain plug, loosen lock nut, then turn adjusting nut until plug is expanded to a diameter which will provide a complete seal at opening. Turning adjusting nut clockwise will expand plug. Tighten lock nut firmly after making adjustment.

Filling and Treating Chemical Tank

NOTE: Before performing operation, make sure chemical tank drain plug is properly installed.

1. In engine compartment, remove protector cover from fitting (4, fig. 32), then connect water supply service hose to fitting. Open water pressure into fitting.

2. Using hose (11, fig. 32) located in compartment under wash basin, fill chemical tank through lavatory stool with approximately seven gallons of water. Tank holds approximately 14 gallons; however, it should be only partially filled as recommended.

NOTE: During operation in freezing weather, chemical tank can be serviced with salt water to prevent freezing.

3. Pour one quart of degerm chemicals into chemical tank through lavatory stool. Degerm chemical can be obtained from the Century Chemical Products Company, 520 West Fort Street, Detroit, Michigan, and can be procured in 5 gallon cans, or 15, 30, and 55 gallon drums.

This chemical, mixed with water, will properly treat chemical tank.

WASH BASIN WASTE TANK

Draining into Chemical Tank

1. In engine compartment, open drain valve (1, fig. 32). Drain water will flow through drain line (8, fig. 32) into chemical tank.

2. Close valve after draining.

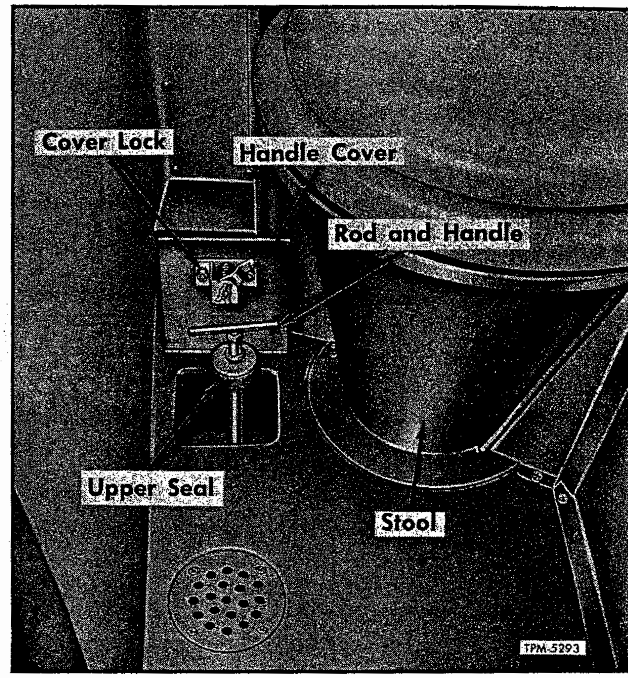


Figure 36—Chemical Tank Drain Plug Handle and Rod

Draining Out Through Side Fitting

1. In engine compartment, remove protector cover from fitting (2, fig. 32). Attach drain service hose to fitting.

2. In lavatory compartment, open access door under wash basin and open valve (10, fig. 32). Water will flow through service hose to sewer opening or receptical.

3. Leave drain service hose connected and drain valve open until flushing operation is completed.

Flushing Out Through Side Fitting

1. In small compartment under wash basin, open valve (10, fig. 32).

2. In engine compartment, remove protector covers from flushing fitting (3, fig. 32) and from flushing drain fitting (2, fig. 32). Connect water supply service hose to fitting (3, fig. 32) and connect drain service hose to fitting (2, fig. 32).

3. Open water supply which will flow up through flushing line and into tank through a shower head type spray nozzle.

4. Flushing water will flow out through drain fitting (2, fig. 32) and out through drain service hose into sewer or receptical.

5. Close drain valve under basin.

6. Disconnect service hoses and install protector covers over fittings.

Reverse-Flushing Out Through Side Fitting

This operation is performed by intermittently applying water pressure into wash basin flushing-

LAVATORY

drain fitting at side of coach, and letting the residue drain back out same fitting. Catch residue and water in a container.

NOTE: Valve in compartment under wash basin must be open when reverse-flushing tank.

Flushing into Chemical Tank

1. In engine compartment, open drain valve (1, fig. 32) and connect water supply service hose to flushing fitting (3, fig. 32).
2. Open water pressure which will flow into tank through a shower-head type spray nozzle.
3. Flushing water will flow out through line (8, fig. 32) and into chemical tank.
4. Close drain valve (1, fig. 32) after flushing.

VENTILATING BLOWER AND MOTOR

Blower and motor is mounted under lavatory stool riser with four screws, nuts, and washers as shown in figure 29.

Access to blower is gained by removing eight screws which attach stool closure panel to stool and coach side panel. Motor brushes can be replaced without removing unit from mounting.

Removal (Refer to Fig. 29)

1. Remove screw and nut which attaches front end of riser cover to stool assembly. Lift riser cover to expose four blower mounting screws as shown.

Disconnect motor wiring connections, then remove four screws, nuts, and washers which attach motor mounting bracket to stool riser. Lower blower and motor assembly.

3. Remove sponge rubber ring from blower inlet.
4. Loosen blower outlet hose clamp, then separate blower from hose. Remove blower and motor.

Disassembly and Assembly (Refer to Fig. 29)

1. Remove three screws which attach blower shroud to blower body. Remove shroud.
2. Loosen set screw which secures blower wheel to motor shaft.
3. Remove three nuts which attach blower body and mounting bracket to motor support.
4. Pull blower wheel from motor shaft being careful not to distort wheel. Separate parts.
5. Reassemble blower and motor in reverse sequence of above. Position rubber grommets and flat washers as shown. Before tightening blower wheel to blower shaft set screw, make sure blower wheel, when turning will not contact blower body.

Installation (Refer to Fig. 29)

1. Position blower and motor assembly under stool riser and clamp blower outlet hose to blower.
2. Place sponge rubber ring to top of blower, then raise unit to stool riser. Attach blower bracket to riser with four screws, nuts and washers.
3. Connect motor electrical wiring.
4. Attach stool closure panel to stool and coach side panel with eight screws.
5. Lower riser cover and attach to front of stool with screw and hex nut.

WASH BASIN SUPPLY PUMP AND MOTOR

Supply pump and motor, located on floor in back of rear seat on right side of coach (fig. 30) can be readily removed for service; however, it is not necessary to remove pump and motor to replace motor brushes. Access to motor for replacing brushes can be obtained by removing rear seat inner cushion. To remove motor and pump, it is recommended that entire rear seat be removed.

Removal (Refer to Fig. 30)

1. Drain water supply tank as directed previously under "Wash Basin Water Supply Tank."
2. Disconnect electric wiring at motor.
3. Disconnect water lines at pump connections. (See illustration of removed unit.)
4. Remove bolts which attach pump bracket to floor. Remove pump and motor with mounting bracket and check valve (fig. 30).
5. Remove two bolts attaching mounting bracket-to-pump adapter flange. Remove bracket-to-flange gasket.
6. At outlet flange of pump, remove two bolts which attach outlet flange, and restriction plate to pump body. Remove plate, restriction plate and gaskets.

Disassembly, Inspection, and Repair

Refer to "Booster Water Pump" under "HEATING AND VENTILATION" for procedures which will apply, covering disassembly, inspection, repair, and assembly of pump and motor.

Installation (Refer to Fig. 30)

NOTE: Before installing gaskets to pump flanges make sure flange surfaces are clean and smooth, then apply permatex sealing compound to gasket surfaces and to all connection fittings.

1. At outlet flange, install new gaskets, restriction plate, and outlet flange, positioned as shown. Install 3/8 x 7/8" flange bolts evenly and firmly.
2. At pump inlet adapter, install new gasket then attach pump mounting bracket to pump adapter with two 3/8 x 3/4" bolts and lock washers. Install line connector in mounting bracket.
3. To water outlet flange, assemble elbow, nipple, check valve, and line connector as shown.

IMPORTANT: Plug of water check valve must be positioned at top side. See illustration. Otherwise check valve ball will fail to seat in valve body, making valve useless.

4. Place unit to lines, then loosely connect water line connections and pump drain cock line. Attach pump bracket to floor. Final tighten all line connections.

5. Connect motor electrical wiring.

6. Fill supply tank, operate pump, and check for leaks.

WASH BASIN SUPPLY LINE CHECK VALVE

Check valve is installed in basin supply line as shown in figure 30. Valve is of ball-type, and serves to maintain a full supply line to basin faucet, thus preventing a delayed surge of water after pressing water pump switch.

When a delayed surge occurs, the valve should be cleaned and inspected as follows:

1. Remove seat inner cushion from right rear seat and drain the wash basin supply tank.

2. Pack pieces of cloth under and around top of valve body to soak up water in line and drain basin water supply tank.

3. Using a 9/16" open-end wrench, remove plug from top of valve body. Remove check ball.

4. Examine check ball for pitted or damaged condition. Replace check ball if necessary.

5. Clean out valve body, install check ball and reinstall valve plug. Tighten plug firmly.

WASH BASIN PUMP AND WATER SUPPLY LINE DRAIN COCKS

Lavatory system is equipped with two drain cocks for the purpose of draining water pump and pump-to-basin supply line when subject to freezing conditions. Drain cock in supply line is accessible in engine compartment (7, fig. 32). Water pump drain cock is located at bottom of pump body as shown in figure 30.

NOTE: Drain water supply tank before opening drain cocks and close cocks before filling.

SOAP DISPENSER

When soap dispenser supply tank requires filling, turn plunger cap which is threaded into dispenser body, then remove cap. With cap removed, pour liquid soap into tank until full, then thread plunger cap into dispenser body.

EMERGENCY BUZZER

Lavatory emergency buzzer, mounted under dash in front of driver, sounds only when emergency switch in lavatory compartment is pressed. Refer to Lavatory Wiring Diagrams (MD-83294 or MD-84004) in back of manual for circuit continuity.

Maintenance

At regular intervals, remove cover of buzzer and inspect points for burning, corrosion, or other defects. Clean or replace points as necessary.

Tests

If buzzer fails to operate, when switch button is pressed, proceed as follows:

1. Make sure points are clean and in contact and that terminal screws are tight.

2. Use voltmeter and test for current at feed terminal. When no current is obtained, circuit is open between No. 6 circuit breaker and buzzer terminal.

3. When current is obtained at buzzer feed terminal, and buzzer still fails to sound, check for current at opposite terminal. When no current can be obtained at this terminal buzzer coil is probably open circuited. If current is obtained, ground terminal with a jumper wire and if buzzer sounds, switch circuit is defective. If buzzer still fails to sound it can be considered defective and should be replaced.

4. When foregoing tests indicate that buzzer is satisfactory, remove switch button; then ground wire leading to buzzer. If buzzer sounds, switch is defective and should be replaced. If buzzer fails to sound, wiring between switch and buzzer is defective.

DOOR LATCH SWITCH

Switch mounted in partition at front of lavatory compartment door (fig. 31) is adjustable in or out to make contact with door inside lock bolt when lock lever is positioned for locking door.

Switch Adjustment (Fig. 31)

1. Remove two cross-recessed screws which attach switch cover plate to front partition, then remove plate.

2. Inside the compartment, remove two screws which attach switch bracket to partition. Pull switch and bracket from front opening.

3. Loosen two screws which attach switch to mounting bracket having two attaching screw slots purposely at back side for adjusting switch position. Squeeze bracket and switch to ends of slots. Tighten switch screws firm, but not excessively, in spring nuts. Reinstall switch and bracket to partition.

4. From inside lavatory compartment, close door and lock. NOTE: Extra effort will be required to lock door first time as action will force switch to proper position on mounting bracket. Switch will be retained in position by attaching screw spring nuts. Check switch operation.

5. Reinstall switch cover and latch plate.

Specifications

BODY

PASSENGER CHIME

GM Part Number	2164961
Type	Single Tone

HEATING AND VENTILATION

UNDERFLOOR HEATER BLOWER MOTOR

Make	Delco Products
Model	A-7708
H.P.	3/4
Volts	12
Rotation (Commutator End)	Counterclockwise
RPM	1250 (Low Speed)
	1750 (High Speed)

HEATER BLOWER MAGNETIC SWITCHES

Make	Essex Wire Corp.
Type	70-111224
Volts	12

GRAD-U-STAT

Make	Minneapolis-Honeywell
Type	TO-900F6

MODULATION VALVE

Make	Minneapolis-Honeywell
Type	V0511AY1
GM Number	2301731

HEATING SYSTEM PRESSURE REGULATOR VALVE

Make	Minneapolis-Honeywell
Type	73-26
Setting	10 p.s.i.

LAVATORY

WATER SUPPLY TANK

Capacity	17-3/4 Gal.

WASH BASIN DRAIN TANK

Capacity	17-1/2 Gal.

CHEMICAL TANK

Total Capacity	14 Gal.
Water Required After Cleaning	7 Gal.

WATER PUMP MOTOR

Make	Universal Electric
Model	8-025
Type	Series Wound
Volts	12 DC
Amperes	5
Rotation (Shaft End)	Clockwise
RPM	3400

VENTILATION BLOWER MOTOR

Make	Universal Electric
Model	4-107-9
Type	Series Wound
Volts	12 DC
Amperes	3
Rotation (Shaft End)	Clockwise
R.P.M.	3000

Brakes

This group contains maintenance and repair information on BRAKES. The four sections of the group are shown in index below:

Air Brakes

AIR SYSTEMS

Air systems in coaches are made up of a group of devices. Some of these devices maintain a supply of compressed air, some direct and control the flow of the compressed air, and others transform the energy of compressed air into the mechanical force and motion necessary to accomplish their particular function. Only those units with functions directly related to the vehicle braking system are covered in this section. Information on other air system units will be found in other sections of this manual as shown later under "Index of Air Control Units."

To simplify the following explanation, the air system (fig. 1) will be divided into four interconnected systems: Main Air System, Auxiliary Air System, Air Suspension Air System, and Engine Step and Radiator Shutter Control System. Each system is described separately below:

MAIN AIR SYSTEM

The main air system supplies and controls air pressure for operation of the vehicle braking system. It also supplies air pressure to the auxiliary air system after pressure has been built up to a point sufficient for safe operation of brakes, and to the engine stop and shutter control system.

AUXILIARY AIR SYSTEM

The auxiliary air system supplies air pressure to the air suspension system, air horn, windshield wipers, and heating system controls. The air pressure gauge on gauge panel is also connected to the auxiliary air system.

AIR SUSPENSION AIR SYSTEM

Air suspension air system includes the height control valves, air beams, air bellows, and several air filters. This system is illustrated in more detail and is fully described in AIR SUSPENSION (SEC. 14).

ENGINE CONTROL SYSTEM

Engine stop and shutter control air system is supplied directly from the main air system. Units used are covered in other sections of this manual as indicated later under "Index of Air Control Units."

OPERATION

MAIN AIR SYSTEM

Compressed air, supplied by the air compressor, is discharged through the discharge muffler into the rear air tank. Compressed air is directed from this tank into the front main air tank. Air line leading from top of front tank delivers air pressure to the rear of the vehicle for operation of the air compressor governir, and supplies air to the engine stop and shutter control system. Two air lines lead from a tee at left end of front air tank. One line delivers air pressure to the rear brake relay valve; the other line delivers air pressure to the brake application valve, low air pressure switch, and, by way of the pressure regulating valve, to the auxiliary air tank.

The pressure regulating valve permits air pressure to pass into the auxiliary air tank when pressure in the main air system reaches 65 psi. The low air pressure switch closes an electrical circuit in the tell-tale alarm system when pressure in the main air system is below the valve setting (60 psi, plus or minus 6 psi). This causes the buzzer to sound and the low air pressure tell-tale to light.

When brakes are applied, air pressure passes through the brake application valve to the front brake chambers, stop light switch, and relay valve. Pressure to relay valve only operates the valve, permitting air pressure direct from air tank to pass through the valve into the rear brake chambers.

When brakes are released, air pressure in the rear brake chambers is exhausted at the relay valve. Air pressure in front brake chambers, stop

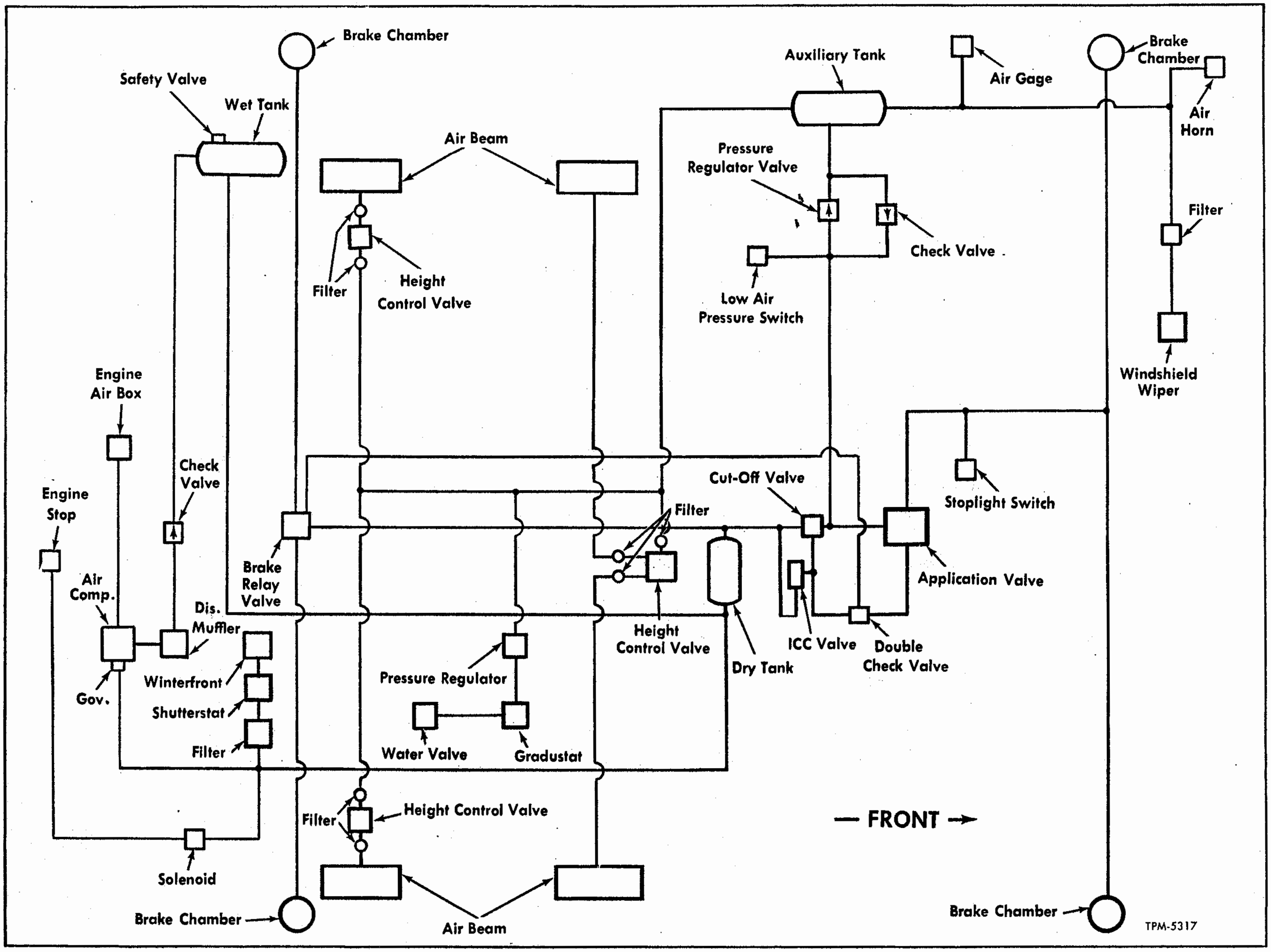


Figure 1—Air Line Diagram

light switch, and line leading to relay valve is exhausted at the application valve.

AUXILIARY AIR SYSTEM

No air pressure is admitted into the auxiliary air system until pressure in main air system reaches 65 psi. When pressure reaches 65 psi, the pressure regulating valve permits air pressure to pass into the auxiliary air tank. Two air lines lead from a tee at top of auxiliary air tank. One line delivers air pressure to the air suspension height control valves, and the other delivers air pressure to the air horn foot valve, windshield wiper control valves, and air pressure gauge.

When pressure in the main air system drops below 65 psi, compressed air in the auxiliary air system returns to the main air system through the one-way check valve. Air in suspension system, however, is not released. Check valves in height control valves prevent air in suspension system from returning to auxiliary air system.

INDEX OF AIR CONTROL UNITS

*Special Equipment.

MAINTENANCE

Procedures for testing, adjusting, and overhauling the various units in the air brake system are described under individual headings later in this section.

It is imperative that all air tanks and air compressor discharge muffler be drained daily to discharge any condensation which has collected. Refer to "Air Tanks" later in this section for location of air tanks and drain cocks.

The complete air system should be checked for leakage at regular intervals. With engine stopped and brakes released, observe rate of air pressure drop registered by the dash gauge. The rate of drop should not exceed two pounds per minute. With engine stopped and brakes fully applied, observe the rate of air pressure drop registered by the dash gauge. Rate of drop should not exceed three pounds per minute. If leakage is excessive, leakage tests should be made at air line connections and at all air brake control units as directed under individual headings later in this section.

In cold weather, particular attention should be given to draining moisture from the air system. When necessary to protect the system against freezing as in cases of extreme cold weather, an alcohol evaporator should be used to introduce alcohol vapor into the system.

Refer to "AIR COMPRESSOR AND GOVERNOR" section later in this group for information on air compressor and governor.

BRAKE ADJUSTMENT

BRAKE SHOE ADJUSTMENT

Brake adjustment for normal lining wear is made by turning slack adjuster worm shaft (fig.20). Brake chambers and slack adjusters installed are shown in figures 21 and 22. Brake chamber push rod travel should be checked after every 2,000 miles of operation to determine whether adjustment is necessary. While maximum travel, listed in "Specifications" at end of this group, is permissible, travel should be maintained as short as possible without brakes dragging for braking efficiency and economy in air consumption. Brake linings

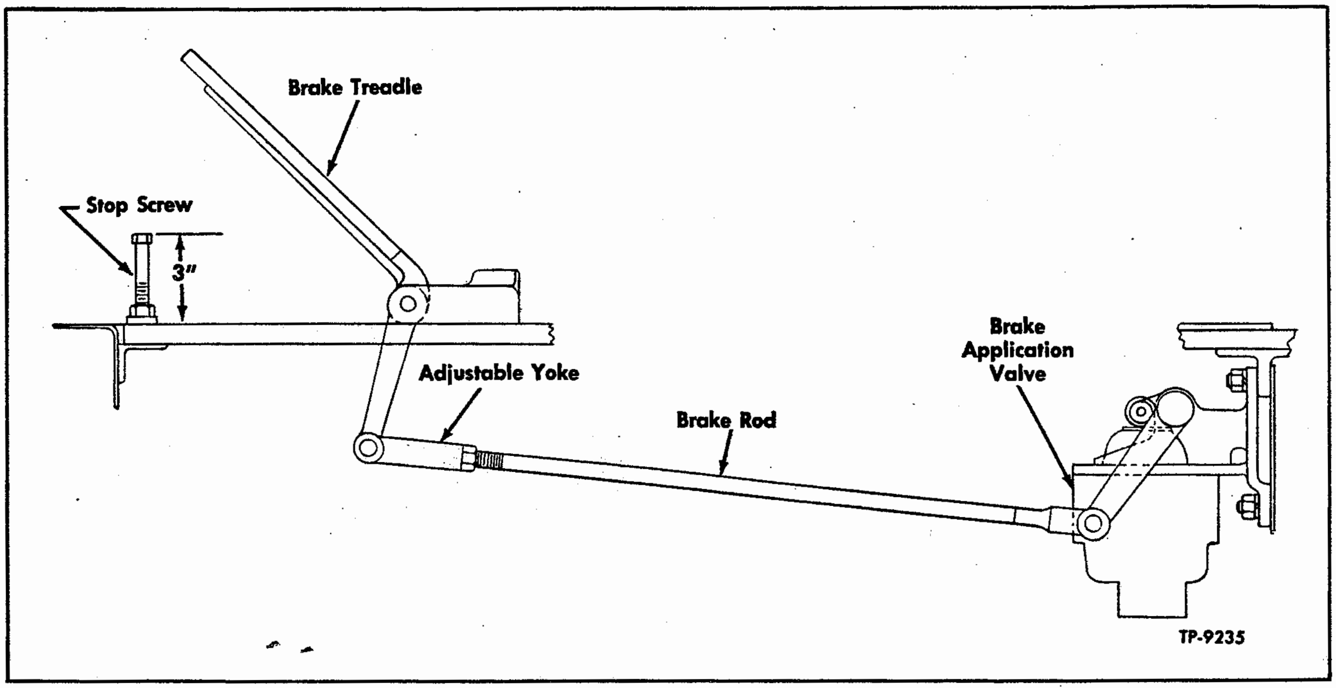


Figure 2—Brake Treadle and Linkage

should be replaced when worn to a thickness of 5/16" at center of shoe.

1. Always check wheel bearing adjustment and correct if necessary before attempting to adjust brakes. Refer to "HUBS AND BEARINGS" (SEC. 19).

2. With wheel jacked up, turn slack adjuster worm shaft until brake drags, then back off until wheel turns freely. NOTE: Lock sleeve must be pushed in before worm shaft can be turned. Make sure sleeve is pushed in far enough to clear hex end of worm shaft before turning shaft.

3. Be sure wheel turns freely with no brake drag when brakes are fully released. After completing adjustment, make sure lock sleeve comes out and engages hex end of worm shaft. Pry sleeve out with screwdriver if necessary. Coat lock sleeve and end of worm shaft with wheel bearing grease after completing adjustment. This keeps out dirt and water, and assures free movement of sleeve at next adjustment.

BRAKE TREADLE LINKAGE ADJUSTMENTS (Fig. 2)

These adjustments should not normally be required except when brake treadle, brake rod, or application valve have been replaced.

1. Disconnect flexible hose from one of the front brake chambers and connect a test air gauge to hose.

2. Build up air pressure in system to normal operating pressure (100-105 psi).

3. Adjust stop screw on toeboard to dimension shown in figure 2. Tighten lock nut on screw.

4. Press treadle down against stop screw and hold down until pressures balance, then note readings on test air gauge and dash air gauge. Readings should be approximately the same (within 5 psi).

5. If full tank pressure is not being delivered, disconnect brake rod adjustable yoke from brake treadle and turn yoke to lengthen rod enough to obtain full tank pressure. CAUTION: Do not lengthen rod more than one half turn of yoke after full tank pressure is obtained with treadle against stop on toeboard. Lengthening brake rod too much will cause over-travel of application valve operating lever and may damage the valve diaphragm. (After correct rod length has been obtained, tighten lock nut against yoke.

6. Place a 0.109" feeler gauge between roller and valve cap at brake application valve. Back operating lever stop screw (30, fig. 10) up against lug on lever until valve delivers 5 to 7 pounds pressure. Gauge must return to zero when feeler is removed. Tighten lock nut on stop screw. Remove test air gauge and reconnect flexible hose to brake chamber.

AIR COMPRESSOR DISCHARGE MUFFLER

Air compressor discharge muffler, mounted in top of engine compartment at right side, is connected by a flexible air line to the air compressor discharge fitting. Purpose of muffler is to arrest the pulsation noises (ping) caused by discharge of compressed air from the reciprocating air compressor. Discharge muffler is shown in figure 3.

Since the discharge muffler is the first unit the hot compressed air enters, considerable condensation collects in the unit. This condensation must be drained daily. Drain cock and drain tube are installed at lower side of muffler. Drain cock is open with handle at right angle to body, and is closed with handle parallel to body.

Muffler should be removed at regular intervals and the inside cleaned of carbon deposits or other foreign material.

AIR TANKS

Three air tanks are used in vehicle air system, two main tanks and an auxiliary tank. The purpose of the air tanks is to provide a place to store compressed air so that there will be an ample supply available for immediate operation of brakes and other air-operated equipment. Tanks also provide storage for sufficient compressed air for several brake applications with engine stopped.

Another purpose of the tanks is to provide a place where the air heated during compression can cool, and the oil and the water vapors can condense. Most of this condensation takes place in the rear or "wet" tank. Condensation must be drained from all air tanks daily. To drain tanks properly, leave drain cocks open until all air escapes, and until draining stops.

All air tank mounting bolts should be checked for looseness at regular intervals and tightened if necessary. Air tanks may be cleaned inside using steam or hot water. Inspect tank for corrosion or other damage. If corrosion or other damage has weakened the tank, it must be replaced. Location of each air tank is described below.

<u>Rear Tank</u>

Rear air tank is installed in a vertical position at outer side of vehicle immediately rearward of left rear wheelhousing. Drain cock at bottom of tank is recessed key type. A special tool, which can be made locally, or a large L-shaped screwdriver must be used to open and close drain cock. Dimensions for making tool are shown in figure 4.

<u>Front Tank</u>

Front main air tank is mounted horizontally under floor in back of spare tire compartment, and is accessible from under vehicle. Drain cock is installed in center of tank at bottom. Drain cock is closed with handle at right angle to body, and open with handle parallel to body.

<u>Auxiliary Tank</u>

Auxiliary air tank is mounted horizontally in top of compartment at left front corner of vehicle, and is accessible after opening compartment door. Drain cock, with drain tube extending through the compartment floor, is installed in bottom of tank. Drain cock is closed with handle parallel to body, and open with handle at right angle to body.

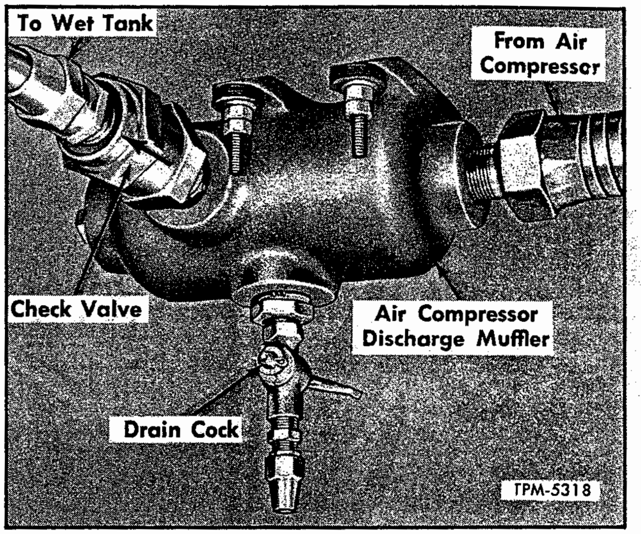


Figure 3—Air Compressor Discharge Muffler Installation

SAFETY VALVES

A safety valve, shown in figure 5, is installed in the rear air tank to eliminate the possibility of air pressure building up in the system beyond a set maximum.

OPERATION

When reservoir pressure is built up to exceed 150 pounds, force of air pressure forces ball (4) off seat (B), permitting air pressure in excess of 150 pounds to escape through exhaust port (A) to atmosphere. After pressure bleeds down, spring (3) forces ball (4) back on seat (B).

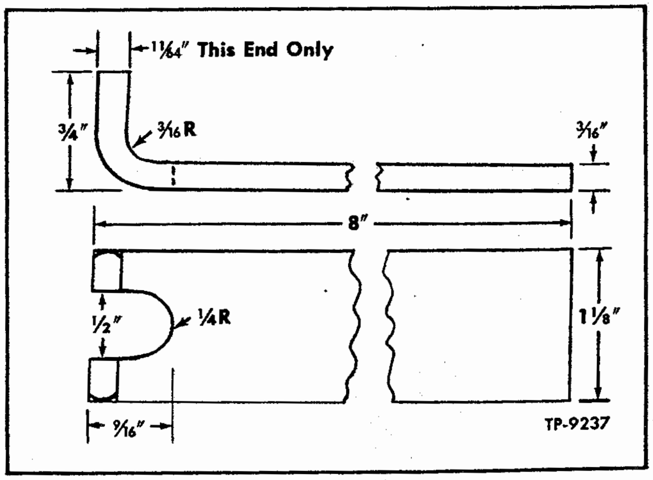


Figure 4—Special Tool For Recessed Key Type Drain Cock

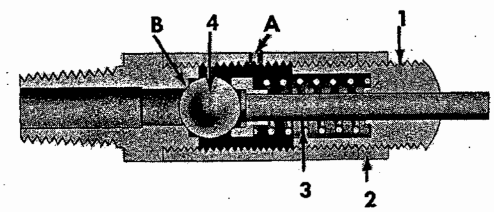


Figure 5—Safety Valve

MAINTENANCE

Check safety valve periodically for leakage, using soap suds at exhaust port. Leakage should not exceed a 1-inch bubble in 5 seconds. Once a year, valve should be dismantled, cleaned with kerosene, and reset to blow off at 150 pounds.

ADJUSTMENT (Fig. 5)

Set safety valve in following manner:

1. Loosen lock nut (2).
2. Adjust set pressure by turning adjusting nut (1). Turn nut clockwise to increase pressure, or counterclockwise to decrease pressure.
3. Tighten lock nut (2).

AIR LINES

Metal tubing and flexible hose are used to connect the various units of the air brake system. Service instructions for both types follow:

METAL TUBING

Metal air lines are of annealed copper tubing with three-piece compression type fittings. Flared type fittings should never be used in air brake systems. Connections should be tested for leakage at least every 5,000 miles and tightened or replaced if necessary. When replacing metal tubing, tubing must be free of burrs, copper cuttings, and dirt. Blow out with compressed air. Any of the above mentioned particles will destroy sealing seats in air control units. New tubing must be of the same size as the old tubing.

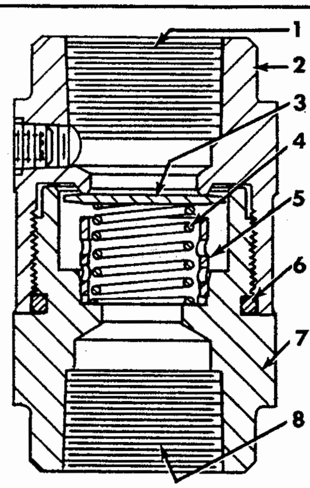


Figure 6—Discharge Line Check Valve

FLEXIBLE HOSE

Flexible hose is used at each brake chamber where it is impossible to use metal tubing due to constant flexing during vehicle operation. Hose connections should be tested for leakage at least every 5,000 miles and tightened or replaced if necessary. Any hose which is chafed, worn, or kinked should be replaced.

SERVICEABILITY TESTS

1. Operating Test

If any trouble symptom such as slow brake application or slow brake release, indicates restricted or clogged air line, disconnect the suspected tube or hose at both ends and blow through it to make sure the passage is clear. Inspect tubing and hose for partial restriction such as would be caused by dents or kinks. If such a condition is found, tubing or hose should be replaced.

2. Leakage Test

With air system fully charged and brakes applied, coat all tubing and hose connections with soap suds to check for leakage. No leakage is permissible. Leakage can sometimes be corrected by tightening the connection. If this fails to correct leakage, new fittings, metal tubing, or flexible hose must be installed.

AIR PRESSURE GAUGE

The air pressure gauge in the instrument panel is connected into the air lines supplies by the auxiliary air tank. Since the gauge receives its air pressure from the auxiliary air tank, it will register no increase in pressure until the pressure in the main air brake system is built up above 65 pounds; however, the gauge will register a decrease in pressure, regardless of pressure in system, since pressure in auxiliary air system returns to main air brake system as the pressure in the latter system is reduced.

The vehicle should never be put in motion until the air pressure registers at least 65 pounds. If pressure drops below 60 pounds (low pressure buzzer sounds), stop vehicle immediately and determine cause of pressure loss. Check gauge regularly with an accurate test gauge. Replace unit if reading varies four pounds or more.

DISCHARGE LINE CHECK VALVE

One-way check valve (fig. 6) is installed in air compressor discharge line at the outlet of the compressor discharge muffler. This valve performs no function in the air system except as a safety device. In the event of leakage or breakage in the line from air compressor to muffler, check valve prevents loss of air pressure from the air system. Check valve should be removed, disassembled, and cleaned at regular intervals. Valve disc should be turned over if worn on one side, and a new seal ring should be used when assembling. When installing valve, make sure it is installed to permit air flow in direction of arrow on valve body.

LOW AIR PRESSURE SWITCH

Low air pressure switch (fig. 7) is a safety device designed to automatically give a warning when pressure in air system falls below a safe limit for brake operation. The low air pressure switch is actually an air controlled switch in an electrical circuit, automatically controlling a tell-tale light and buzzer. Operation of tell-tale alarm system is explained in "WIRING AND MISCELLANEOUS ELECTRICAL" in ELECTRICAL (SEC. 7). Low air pressure switch is mounted in compartment at left front corner of vehicle, and is connected into the feed line to the brake application valve. Refer to "Alarm and Signal Wiring Diagram" in back of this manual for electrical circuits.

OPERATION (Fig. 7)

When system air pressure under the diaphragm is above 60 pounds, the force exerted by the air pressure overcomes the force exerted by the diaphragm spring above the diaphragm, and the electrical contacts remain open.

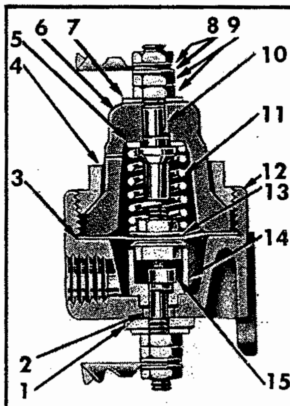
When the air pressure drops below 60 pounds, the diaphragm spring exerts a force above the diaphragm which is greater than the force exerted by the air pressure below the diaphragm. This will cause the diaphragm to move down and close the electrical contacts. This completes electrical circuit to buzzer and tell-tale light, informing driver of his impending loss of air pressure.

The nominal pressure setting of 60 pounds is subject to a tolerance of plus or minus 6 pounds so that the actual operating pressure of the low air pressure switch may vary between 66 pounds maximum and 54 pounds minimum.

SERVICEABILITY TESTS

1. Operating Test

Operation of the low air pressure switch may be checked by reducing the system pressure and being sure that the contacts close when the reservoir pressure is between 66 pounds maximum and 54 pounds minimum. The contacts will be closed when the tell-tale light and electrical buzzer operate.



1 Terminal Washer
2 Grommet
3 Diaphragm Assembly
4 Cover Retainer
5 Washer
6 Cover
7 Clamping Washer
8 Washers
9 Nuts
10 Terminal Screw
11 Spring
12 Body
13 Shims
14 Terminal Bushing
15 Terminal Screw

Figure 7—Low Air Pressure Switch

2. Leakage Test

A small vent hole is provided in the cover of the low air pressure switch to check the condition of the diaphragm. Cover the vent hole with soap suds. If a leak is indicated it signifies a ruptured diaphragm. The diaphragm should then be replaced.

DISASSEMBLY (Fig. 7)

1. Unscrew cover retainer (4) from body (12).
2. Remove cover (6) and lift out spring (11) and diaphragm assembly (3).

CLEANING AND INSPECTION

Clean all metal parts in cleaning solvent. Examine diaphragm for signs of cracking, wear, or damage. Replace diaphragm if these conditions are found.

Inspect contact points for signs of pitting or wear. If pitting is not too severe, contacts may be reconditioned by filing with a fine distributor point file. If they cannot be reconditioned, they should be replaced.

Check spring for tension. If it has lost its tension, it should be replaced.

ASSEMBLY (Fig. 7)

1. Position diaphragm assembly (3) in body (12).
2. Place spring (11) so it will be on the upper diaphragm follower.
3. Place cover (6) over diaphragm (3). Install cover retainer (4) over cover (6) and thread into body (12). Tighten retainer firmly.
4. Test switch as previously directed under "Serviceability Tests." If pressure setting requires adjustment, add or remove shims (13) under spring.

PRESSURE REGULATING VALVE

Pressure regulating valve (fig. 8), mounted in compartment at left front corner of vehicle, is connected into the air line leading to the auxiliary tank. The unit consists essentially of a valve diaphragm and spring, enclosed by a valve body and cover. Adjustment is made by means of the adjusting screw in the cover.

The pressure regulating valve serves two purposes in the air system. One purpose is to prevent air pressure from entering the auxiliary air system until pressure in the main air brake system reaches 65 pounds. This provides a rapid build-up of pressure in the main air brake system for operation of brakes. When air pressure in main air brake system reaches 65 pounds, the pressure regulating valve admits pressure into the auxiliary air system for operation of windshield wipers, air horn, and air pressure gauge, and supplies air pressure to the air suspension system. The second purpose of the pressure regulating valve is to prevent lowering pressure below 65 pounds in main air brake system by operating windshield wipers or air horn, or by leakage in the auxiliary air system air lines.

SERVICEABILITY TESTS

1. Operating Test

Exhaust air pressure from system and install a test gauge in air brake system, preferably in the air line leading from air tank to the pressure regulating valve. Disconnect one of the windshield wiper air lines at the wiper motor. Build up pressure in system and note pressure when the valve permits air to pass to atmosphere. If pressure varies 5 pounds from the original setting (65 lbs.), the valve requires adjustment.

2. Leakage Test

With air line disconnected at bottom of valve and pressure in air brake system below the valve setting (65 lbs.), coat the bottom opening of valve with soap suds. Leakage is caused by dirt on the valve seat or by an excessively worn valve.

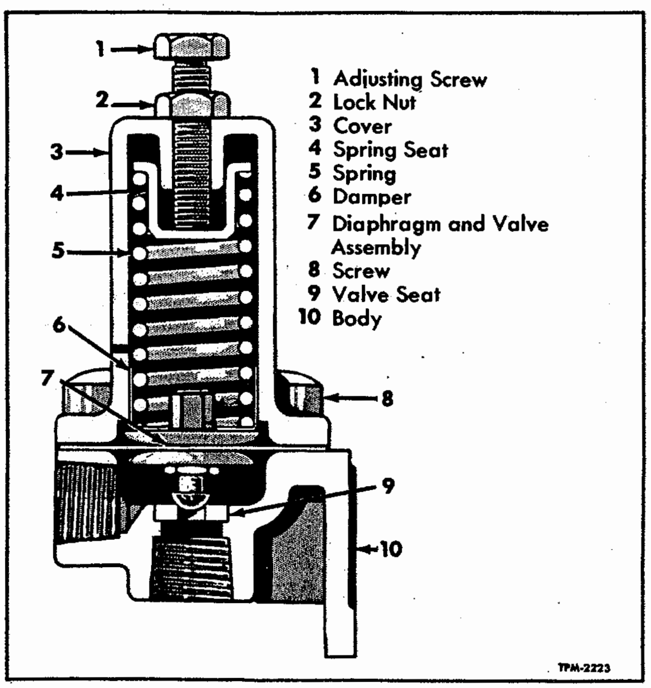


Figure 8—Pressure Regulating Valve

ADJUSTING SET PRESSURE (Fig. 8)

The pressure at which the valve is unseated is controlled by the adjusting screw (1). Setting may be increased or decreased by turning screw.

1. Back off lock nut (2), then turn screw (1) clockwise to increase pressure, or counterclockwise to decrease pressure.

2. Tighten lock nut (2) when correct adjustment is obtained.

REPLACEMENT

1. Removal

Exhaust air from system and disconnect air lines. Remove mounting bolts and remove unit from vehicle.

2. Installation

Position unit and install mounting bolts. Connect air lines and test valve as previously directed under "Serviceability Tests."

DISASSEMBLY (Fig. 8)

Remove four screws (8) attaching cover (3) to body (10) and remove cover. Remove spring (5), spring seat (4), and damper (6) from cover and lift diaphragm and valve assembly (7) off body.

INSPECTION (Fig. 8)

Clean all parts thoroughly, using a suitable cleaning fluid. Examine diaphragm for cracks or wear. If either the valve or diaphragm are worn or damaged, a new diaphragm and valve assembly should be installed. Inspect valve seat in body. If seat is pitted, scratched, or chipped, it should be replaced.

ASSEMBLY (Fig. 8)

Place diaphragm and valve assembly (7) on body, with valve seated in valve seat in body. Install spring seat (4), spring (5), and damper (6) in cover (3) and position cover on body (10). Install four screws (8) through cover and diaphragm into body and tighten firmly. Adjust set pressure as previously directed under "Adjusting Set Pressure."

AUXILIARY AIR SYSTEM CHECK VALVE

Auxiliary air system check valve (fig. 9), consisting of a valve body, valve, and valve cap, is connected into air lines at pressure regulating valve. This valve is a one-way valve, permitting air pressure to flow through it in one direction only. Check valve prevents air pressure flowing into the auxiliary air system without passing through the pressure regulating valve; however, it permits air pressure in the auxiliary air system to return to the main air brake system when the pressure in the main air brake system is reduced. Whenever check valve is removed it is essential that it be reinstalled to permit air flow in direction indicated by arrow on valve body. Mount check valve with valve cap at top.

BRAKE APPLICATION VALVE

Brake application valve (fig. 10) is a lever type D-1 brake valve mounted on bulkhead at rear side of compartment at left front corner of vehicle. Brake treadle, mounted on floor board in driver's compartment, is connected to the application valve operating lever by a brake rod and adjustable yoke (2).

APPLICATION VALVE OPERATION (Fig. 10)

1. Application

As the driver depresses the brake treadle, pressure is transmitted through the lever and roller, valve cap, and spring cage to the pressure regulating spring and diaphragm. As the diaphragm and plunger move downward, the exhaust valve seat contacts the exhaust valve. Continued downward movement of diaphragm and plunger pushes the inlet valve off its seat. This permits air pressure to pass through the inlet valve into the lines leading to the front brake chambers, stop light switch, and rear brake relay valve, applying the brakes.

2. Holding

The compensating port (passage A, fig. 10) in the lower body casting permits the same air pressure being delivered to the brakes to enter the cavity below the diaphragm. When air pressure in cavity below diaphragm balances the mechanical force on top of the diaphragm, the diaphragm moves upward, permitting the inlet valve to close but not enough to open the exhaust valve. This prevents additional pressure from being delivered to the brakes, and at the same time prevents pressure already delivered from escaping through the exhaust valve and exhaust port, and brakes are held in applied position. Should the driver depress the brake treadle still further, exerting additional force

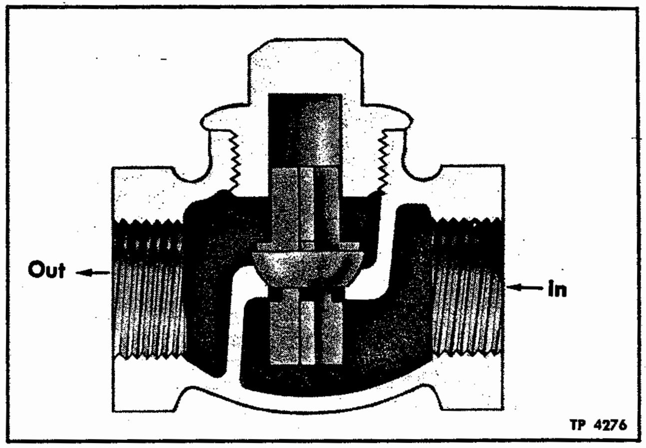


Figure 9—Auxiliary Air System Check Valve

on top of the diaphragm, a corresponding increase in air pressure being delivered to the brakes results.

If the driver depresses the treadle to fully applied position (against stop screw, fig. 2), the pressure regulating spring is compressed and the spring cage bottoms on the spring seat. Under these conditions the inlet valve is held open, permitting full air system pressure to pass through the valve to the brakes.

3. Partial Release

If the driver permits the treadle to partially return toward its released position, reducing the mechanical force on top of the diaphragm, the air pressure below the diaphragm overcomes the mechanical force on top of it. When this occurs the diaphragm lifts, closing the inlet valve and opening the exhaust valve, permitting air pressure delivered to brakes to escape through the exhaust port until the pressure below the diaphragm again balances the mechanical force on top of it.

4. Release

When the driver permits the brake treadle to return to its fully released position, the exhaust valve remains open and all air pressure which has been delivered to the brakes is exhausted and the brakes return to the released position.

APPLICATION VALVE SERVICEABILITY TESTS

1. Operating Tests

a. Check the delivery pressure of the valve, using an accurate test gauge. Disconnect flexible hose from one of the brake chambers and connect test air gauge to hose. With treadle fully depressed against stop on toeboard, test gauge should show approximately full air system pressure as registered by the dash air gauge (within 5 psi).

b. Depress and hold brake treadle in several

positions between fully released and fully applied and make sure the delivered pressure registered by the test gauge varies in accordance with the degree to which the brake treadle is depressed. The valve must control all delivery pressures between 5 and 75 pounds.

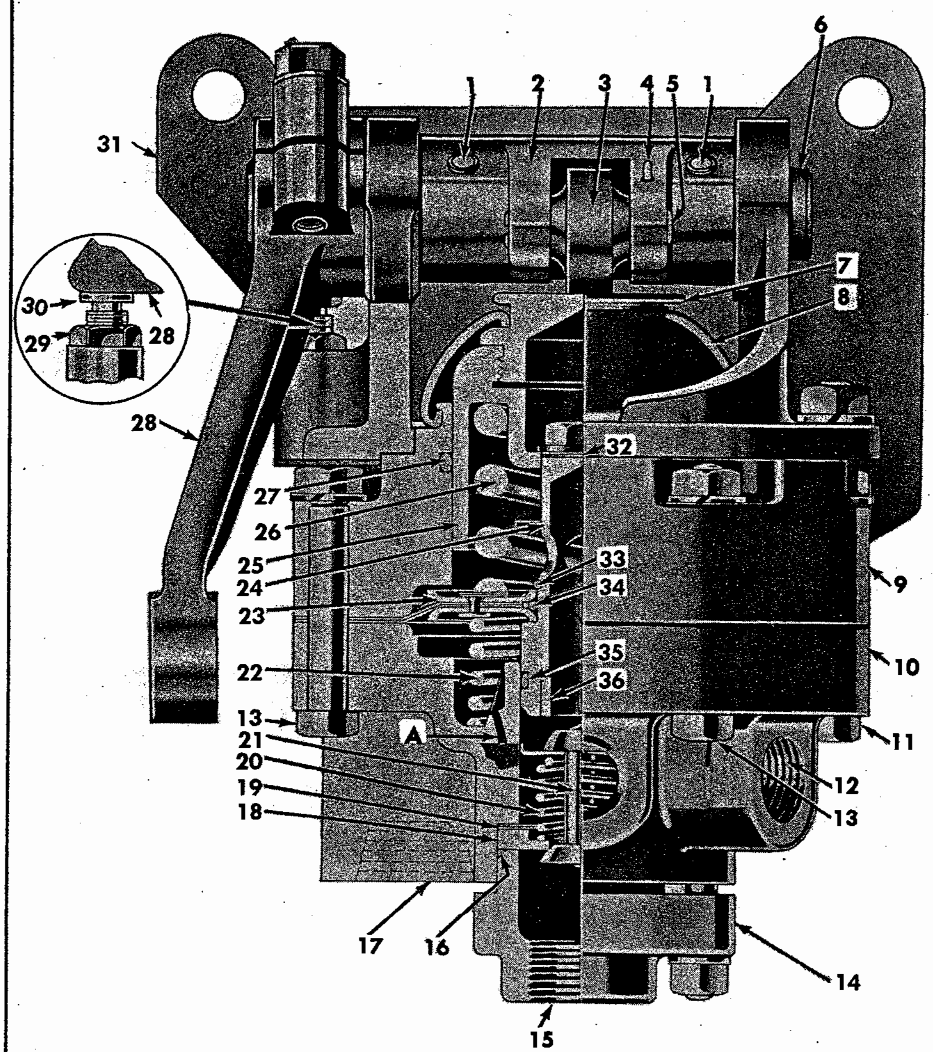
If full system pressure is not delivered, check treadle stop screw and brake rod adjustment as previously directed in this section under "Brake Treadle Linkage Adjustment." If valve does not graduate the delivered pressure properly (between 5 and 75 pounds), it is an indication that passage A (fig. 10) is restricted.

c. With brake treadle fully released, test gauge must register zero. If gauge does not promptly return to zero, check for proper adjustment of brake valve operating lever stop screw. Refer to "Brake Treadle Linkage Adjustment."

2. Leakage Tests

a. With brake treadle fully released, coat the application valve exhaust port with soap suds to check for leakage. Leakage in excess of a one-inch bubble in one second is not permissible. Leakage evidenced by this test may be caused by inlet valve not seating properly.

b. With brake treadle fully depressed, coat the exhaust port with soap suds. Leakage in excess of a one-inch bubble in one second is not permissible. Leakage evidenced by this test may be due to a leaking exhaust valve or a leaking diaphragm.



1 Split Pin
2 Roller Lever
3 Roller
4 Cotter Pin
5 Roller Pin
6 Lever Shaft
7 Valve Cap
8 Boot
9 Upper Body
10 Lower Body
11 Long Body Bolt
12 Outlet Port
13 Short Body Bolt
14 Inlet Valve Body
15 Inlet Port
16 Grommet
17 Exhaust Port
18 Inlet Valve Seat
19 Shims
20 Inlet Valve Spring
21 Inlet and Exhaust Valve Assembly
22 Diaphragm Return Spring
23 Diaphragm Assembly
24 Plunger
25 Spring Cage
26 Pressure Regulating Spring
27 Grommet
28 Operating Lever
29 Stop Screw Lock Nut
30 Stop Screw
31 Mounting Bracket
32 Shims
33 Snap Ring
34 Grommet
35 Grommet
36 Exhaust Valve Seat

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Figure 10—Brake Application Valve

APPLICATION VALVE REPLACEMENT

Removal

1. Exhaust air pressure from air system by opening drain cock in one of the main air tanks.

2. Disconnect all air lines from valve. Stop light switch is connected into outlet line to front brake chambers.

3. Remove cotter pin and clevis pin connecting brake rod adjustable yoke to valve operating lever.

4. Remove nut and lock washer from three bolts attaching brake valve mounting bracket to bulkhead, then remove valve and bracket assembly.

5. Remove air line fittings from valve for installation on replacement unit, observing location and position of each fitting.

Installation

1. Install air line fittings in valve body, using permatex on threads, and tighten firmly. Fittings should be located and positioned as noted when removed.

2. Position valve and bracket assembly on three bolts at bulkhead and attach with lock washers and nuts. Tighten nuts firmly.

3. Connect air lines to brake valve, making sure all connections are tight.

4. Connect brake rod adjustable yoke to valve lever with clevis pin and cotter pin.

5. Build up air pressure in system to normal operating pressure, then test valve as previously directed under "Serviceability Tests," and adjust linkage as directed under "Brake Adjustments" at beginning of this section.

APPLICATION VALVE DISASSEMBLY (Fig.10)

1. Mark valve upper body and mounting bracket in some manner to facilitate reassembling parts in correct position.

2. Remove nut and lock washer from three bolts attaching mounting bracket to valve assembly. Lift bracket and lever assembly off valve upper body.

3. Mark lower body in some manner to identify the location of the three long body bolts which attach the mounting bracket.

4. Pull rubber boot off upper body and valve cap. Remove six bolts holding upper and lower bodies together and separate the bodies. Remove diaphragm return spring from lower body.

5. Push on valve cap to remove diaphragm assembly, pressure regulating spring, spring cage, plunger, and valve cap as an assembly from upper body. Remove grommet from groove in upper body.

6. Remove nuts and lock washers from three studs securing inlet body to lower body. Remove inlet body, grommet, inlet and exhaust valve assembly, and shims from lower body. Tie shims together for use at reassembly. Inlet and exhaust valve assembly cannot be disassembled.

7. Do not disassemble the diaphragm, plunger, and spring cage assembly unless diaphragm or exhaust valve seat require replacement as indicated below under "Inspection."

8. Do not disassemble bracket and levers unless replacement of parts is necessary as indicated below under "Inspection."

INSPECTION

Thoroughly clean all parts in a suitable cleaning solvent, then inspect parts as outlined below.

Diaphragm, Spring Cage, and Plunger Assembly

1. Carefully inspect both diaphragms to make sure they are not cracked or deteriorated. If cracks or deterioration are found, diaphragm and spring seat assembly must be replaced as directed later under "Repair."

2. Inspect exhaust valve seat in lower end of plunger. If seat is tapered or rough, plunger and seat assembly must be replaced as directed later under "Repair."

3. Examine pressure regulating spring for damage. If damaged in any way, spring must be replaced as directed later under "Repair."

Upper Body

Check fit of spring cage in upper body. Cage must be a neat sliding fit in body. Examine diaphragm follower seat on bottom of upper body. Seat must not be damaged in any way which will prevent perfect contact with the diaphragm follower. Check diaphragm seat radius on bottom of body for burrs or nicks. If any of the above conditions are evident, replace upper body.

Lower Body

Check fit of plunger in upper bore of lower body. Plunger should be a neat sliding fit in body. Inspect diaphragm seat radius on top of body. Replace lower body if any damage is evident. Make sure small bleed hole (passage A, fig. 10) is not restricted.

Inlet and Exhaust Valve Assembly

Inspect inlet and exhaust valve assembly for broken spring and worn or damaged valves and seats. If damaged or worn excessively, replace the complete assembly.

Bracket and Lever Assembly

Examine bracket and lever assembly for visible damage. Make sure lever shaft rotates freely in bushings in bracket, and that roller turns freely on roller pin. Check for excessive clearance between shaft and bushings in bracket. If bushings are worn excessively, they must be replaced as directed later under "Repair." If roller is too loose

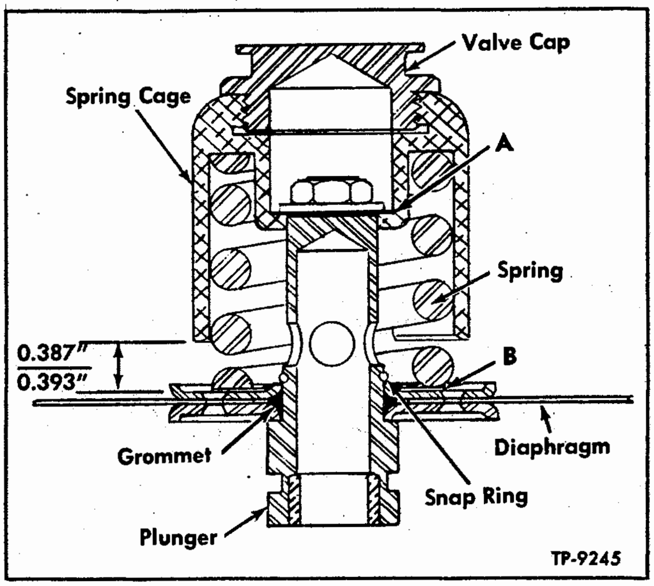


Figure 11—Diaphragm, Pressure Regulating Spring, Spring Cage, and Plunger Assembly

or is seized on roller pin or has flat spots, replace roller or pin as directed later under "Repair." Check fit of new clevis pin in bushing in operating lever. If excessively loose, replace bushing as directed later under "Repair."

REPAIR

The following procedures cover disassembly and assembly for replacement of parts which require replacement as indicated under "Inspection." If equipment for checking preload in pressure regulating spring is not available, the complete diaphragm, spring, spring cage and plunger assembly should be replaced.

Disassemble Diaphragm and Spring (Fig. 11)

1. Remove valve cap from spring cage, holding spring cage with strap wrench or by using a special tool in steps at bottom of cage. Be sure not to score or otherwise damage the spring cage.
2. Remove nut from top of plunger, holding plunger with a rod inserted through the exhaust holes in the plunger. Remove flat washer and shims from top of plunger. Lift spring cage, pressure regulating spring, and shims off plunger. Be sure and keep shims intact for reuse at assembly.
3. Remove snap ring securing diaphragm assembly on plunger, lift off diaphragm, and remove grommet from between diaphragm followers.

Assemble Diaphragm and Spring (Fig. 11)

1. Place new grommet in diaphragm assembly, then place diaphragm assembly over small end of plunger. Install snap ring on plunger to hold diaphragm in place.
2. Place pressure regulating spring shims on diaphragm plate, being sure the same shims that were removed are used.
3. Place pressure regulating spring and spring cage on diaphragm and plunger. Compress pressure regulating spring and install shims, flat washer, and nut on top of plunger. Make sure the same shims that were removed are used. Tighten nut firmly.
4. Check dimension between bottom of spring cage and seat on diaphragm plate. If not within limits shown in figure 11, add or remove shims (A) under flat washer at top of plunger as necessary. After obtaining correct dimension, check preload on pressure regulating spring. If not within 72-80 pounds, add or remove shims (B) under spring as necessary.
5. With nut at top of plunger firmly tightened, stake in place. Thread valve cap into top of spring cage, tighten firmly, and stake in place.

Disassemble Bracket and Levers (Fig. 10)

1. Remove lubrication fitting from end of lever shaft (end opposite operating lever). Loosen clamp screw in operating lever and pull lever off end of shaft. Remove key from keyway in shaft.
2. Drive out two pins securing shaft in roller lever. Push shaft out of bracket and roller lever, then remove roller lever from bracket.
3. Remove cotter pin securing roller pin in roller lever, drive pin out of lever, and remove roller.

Replace Bushings

1. To replace bushing in operating lever, press old bushing out and press new bushing into place. Ream bushing after installation to 0.501" - 0.504".
2. To replace bushings in bracket, press old bushings out and press new bushings into place. Burnish bushings after installation to 0.749"-0.750".

Assemble Bracket and Levers (Fig. 10)

1. Lubricate roller pin and inside of roller with engine oil. Position roller in roller lever, insert pin through lever and roller, and secure pin in lever with cotter pin.
2. Position roller lever in mounting bracket and insert lever shaft through bushings in bracket and through roller lever, aligning pin holes in shaft with holes in roller lever. Refer to figure 10 for correct position of parts. Drive two split pins into lever and shaft.
3. Place key in keyway in shaft, install operating lever on shaft, and tighten clamp bolt in lever. Install lubrication fitting in end of shaft.

NOTE: If for any reason it is necessary to replace roller lever or lever shaft, the two parts must be assembled and drilled to dimensions shown in figure 12.

APPLICATION VALVE ASSEMBLY (Fig. 10)

1. Place lower valve body on bench, bottom side up. Drop inlet valve shims into valve opening in bottom of body, being sure the same shims that were removed are used. Place inlet and exhaust valve assembly in body, with the valve guide inserted in the bore in body.

2. Place new inlet valve body grommet in body on top of inlet valve seat, then install inlet valve body. Install lock washers and nuts on inlet valve body studs and tighten firmly.

3. Turn lower body over and place diaphragm return spring in body.

4. Install new grommets in grooves in plunger and in upper body. Lubricate grommets and surfaces against which they slide with a thin film of graphite grease. Insert spring cage into upper body and align exhaust opening in diaphragm with exhaust port in body.

5. Place upper body and diaphragm assembly on lower body with lower end of plunger inserted in bore in lower body, and with exhaust ports in upper and lower body aligned. Install six body bolts up through lower body, diaphragm, and upper body, making sure the three long bolts are installed in correct holes as marked on lower body prior to disassembly. Install lock washers and nuts on bolts and tighten firmly.

6. Install rubber boot on top of valve assembly, making sure edges of boot are properly seated in grooves in valve cap and upper body. Press down on valve cap several times to make sure the spring cage slides freely in upper body.

7. Place mounting bracket assembly over valve assembly, with marks made prior to disassembly aligned and with the three long body bolts inserted through holes in bracket. Install lock washers and nuts on bolts and tighten firmly.

8. Check travel of inlet valve as follows:

a. Turn operating lever stop screw down to assure full release.

b. Place a depth gauge against the inlet valve by inserting the gauge through the inlet port in the inlet valve body.

c. Move the operating lever to fully applied position (to the limit of its travel) and measure the maximum inlet valve travel. The travel should be 0.148" minimum to 0.156" maximum. If travel is not within limits, remove inlet valve body and inlet and exhaust valve assembly and add or remove shims (19, fig. 10) as required. Add shims to decrease travel, remove shims to increase travel.

REAR BRAKE RELAY VALVE

Relay valve (fig. 13) is mounted on bulkhead above rear axle. Rear brake application and release is made through the relay valve. The supply line from the air tank connects to the cavity in the lower part of the valve, providing a source of high pressure air close to the rear brake chambers at all times. The relay valve and brake application valve are interconnected by a smaller air line which delivers air pressure to the top of the relay valve diaphragm to actuate the valve. In addition to providing more rapid application of the rear brakes, the relay valve also fulfills the function of a quick release valve, permitting rapid release of air pressure from the rear brake chambers.

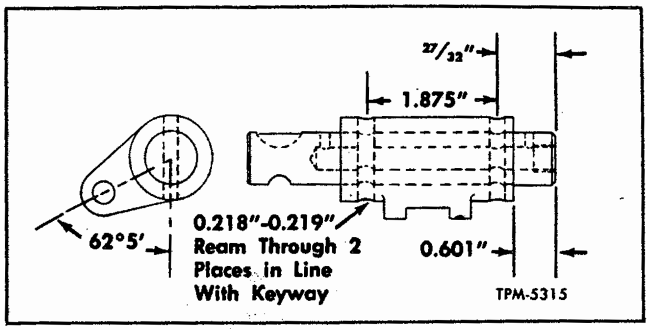


Figure 12—Roller Lever and Shaft Assembly

RELAY VALVE OPERATION (Fig. 13)

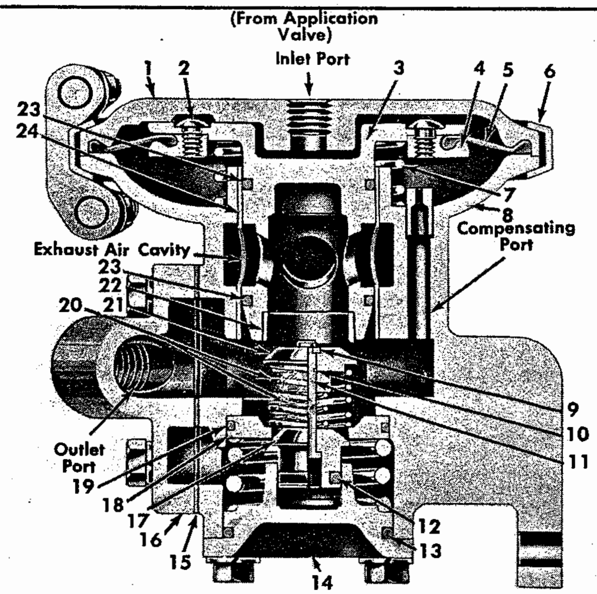
The operation of the relay valve is controlled by air pressure delivered to it by the brake application valve. Air pressure from the brake application valve enters the relay valve above the diaphragm and plunger. Since the space between the diaphragm and cover is small and therefore subject to quick changes in air pressure, the action of the valve in changing its delivered pressures is very rapid.

1. Applying

When driver depresses the brake treadle, air pressure from brake application valve enters the cavity above the diaphragm and plunger and forces the plunger down. As the plunger moves downward, the exhaust valve seat in bottom of plunger contacts the exhaust valve. Continued downward movement of plunger forces the inlet valve off its seat. This permits air pressure from air tank to flow through the inlet valve and into the cavity to which the rear brake chambers are connected.

2. Holding

The compensating port (passage A) permits the same air pressure being delivered to the rear brake chambers to enter the cavity below the diaphragm. When the combined forces of the air pressure below the diaphragm and the plunger return spring balances the air pressure on top of diaphragm and plunger, the plunger moves upward, permitting the inlet valve to close but not enough to open the exhaust valve. This prevents additional pressure



1 Top Cover
2 Screw
3 Plunger
4 Diaphragm Clamping Plate
5 Diaphragm
6 Clamp Ring
7 Plunger Return Spring
8 Body
9 Valve Retaining Ring
10 Valve Stem O-ring
11 Valve Stem
12 Inlet Valve O-ring
13 Bottom Cover O-ring
14 Bottom Cover
15 Adapter Gasket
16 Adapter
17 Inlet Valve
18 Inlet Valve Seat
19 Valve Seat O-ring
20 Valve Spring (Inner and Outer)
21 Exhaust Valve
22 Exhaust Valve Seat
23 Plunger O-ring
24 Plunger Bushing

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Figure 13—Rear Brake Relay Valve

from being delivered to the rear brakes, and at the same time prevents pressure already delivered from escaping through the exhaust port. Thus the relay valve is in holding position, maintaining the same pressure in the brake chambers as the application valve is delivering to it.

Should the driver depress the brake treadle still further, applying additional air pressure to top of diaphragm and plunger, a corresponding increase in air pressure being delivered to the rear brakes results. Should the driver permit the treadle to partially return toward its released position, exhausting some of the air pressure from above the diaphragm, the pressure below the diaphragm overcomes the reduced pressure above it. The plunger then rises, exhausting air pressure from rear brake chambers until the pressure below the diaphragm again balances the pressure above it.

3. Release

When the driver permits the brake treadle to return to fully released position, the application valve exhausts all air pressure from the cavity above the diaphragm and plunger. The pressure below the diaphragm then forces the diaphragm and plunger up, permitting the inlet valve to close and opening the exhaust valve. Air pressure in brake chambers then passes through the exhaust valve and hollow plunger into the exhaust cavity and out the exhaust port to atmosphere.

RELAY VALVE SERVICEABILITY TESTS

1. Operating Test

With air brake system fully charged, apply brakes and observe whether rear brakes apply promptly. Release brakes and make sure air pressure is quickly exhausted from the exhaust port of the relay valve.

2. Leakage Test

Cover relay valve exhaust port with soap suds with brakes released and with brakes applied. Leakage in excess of a one-inch bubble in either of these tests is not permissible. If leakage is evident with brakes released, dirty or damaged inlet valve or seat is indicated. Leakage with brakes applied indicates dirty or damaged exhaust valve.

RELAY VALVE REPLACEMENT

1. Removal

a. Exhaust air pressure from air system. Disconnect air lines from relay valve. To disconnect flexible hose, hold connector body (threaded into elbow) while turning nut (next to spring guard). Spring will turn on hose while unscrewing connector nut from body. Pull hose off tube on connector body.

b. Remove connector body and elbow assemblies, inlet line elbow, and cover fitting for installation on replacement unit.

c. Remove three nuts, lock washers, and bolts attaching valve assembly to bulkhead.

2. Installation

a. Install inlet line elbow, outlet hose elbow and connector body assemblies, and cover fitting on relay valve, using sealing compound sparingly on threads. Tighten firmly, leaving elbows pointing up when fully tightened.

b. Position relay valve on bulkhead and secure with three bolts, lock washers, and nuts. Tighten firmly.

c. Connect air lines to relay valve, making sure all connections are firmly tightened. To connect flexible hose, slide hose over guide on connector body in elbow, then thread connector nut onto body.

d. Build up air pressure in system, then test relay valve as previously directed under "Relay Valve Serviceability Tests."

RELAY VALVE DISASSEMBLY (Fig. 13)

1. Remove four bolts and lock washers attaching outlet adapter to valve body. Remove adapter and gasket from body.

2. Remove four bolts and lock washers attaching bottom cover to valve body. Remove bottom cover, then remove cover O-ring. Remove inlet and exhaust valve assembly from relay valve body. While pressing inlet valve, spread open end of retaining ring and remove ring from neck of stem. Remove exhaust valve, inner and outer springs, inlet valve seat, and inlet valve from valve stem. Remove O-rings from inlet valve, inlet valve seat, and from valve stem.

3. Remove clamp ring bolts, then remove clamp ring. Remove cover, diaphragm and plunger assembly, and plunger return spring. Remove plunger O-rings. Do not disassemble diaphragm and plunger assembly unless necessary to replace parts as indicated later under "Inspection."

4. Remove snap ring holding exhaust check valve in relay valve body. Remove check valve and O-ring from body. Remove screw and washers holding diaphragm on check valve seat. Remove diaphragm.

INSPECTION

1. Thoroughly wash all parts in suitable cleaning solvent. Make sure passage through compensating port and choke insert in body is clean and unobstructed. Discard O-rings, check valve rubber diaphragm and gasket.

2. Examine plunger diaphragm for evidence of cracks or deterioration. If any damage is evident, replace diaphragm as directed later under "Repair."

3. Examine exhaust valve seat in lower end of plunger. If seating surface is cracked or damaged in any way, replace seat as directed later under "Repair."

4. Check fit of plunger in bore in body. Plunger should be a neat sliding fit in bore.

5. Examine exhaust valve, inlet valve, inlet valve seat, valve springs and stem. Replace damaged parts.

6. Check fit of valve stem in bore of inlet and exhaust valve. Check fit of inlet valve in bore of bottom cover. Movement of parts in bores should indicate a neat, sliding fit.

REPAIR

1. Diaphragm or Plunger Replacement

Remove eight screws and seal washers attaching diaphragm clamping plate to upper end of plunger. Remove clamping plate and diaphragm. Place diaphragm bead and clamping plate on plunger flange and attach with eight screws and seal washers. Tighten screws firmly.

2. Exhaust Valve Seat Replacement

If exhaust valve seat requires replacement as previously indicated under "Inspection," remove seat from plunger. Use extreme care when removing seat not to damage the bore in plunger. With chamfered edge of seat to outside, press new seat into plunger, using a suitable driver. Do not damage seating surface.

RELAY VALVE ASSEMBLY

1. Install new O-rings in grooves in plunger, in inlet valve and seat, in valve stem, and in bottom cover.

2. Insert valve stem through inlet valve. With spring groove on opposite side from inlet valve, place valve seat over stem. Place inner and outer springs and exhaust valve over stem. Push down on exhaust valve until neck of valve stem is exposed, then slip retaining ring over neck. Clinch ends of ring around neck slightly with pliers to secure. Coat inlet valve with thin film of graphite grease. Insert inlet and exhaust valve assembly into bore of body. Install bottom cover, and attach with four bolts and lock washers. Tighten bolts firmly.

3. Place plunger return spring on top of valve body. Coat bore surface of plunger with thin film of graphite grease. Insert plunger in bore of body. Place cover on body with groove in cover engaging outer bead on diaphragm. Place clamp ring around cover and body flanges, with the clamp bolt lugs toward outlet side of valve body. Draw clamp ring lugs together. Install bolts, lock washers, and nuts and tighten firmly.

4. Center new diaphragm on concave side of exhaust check valve seat. Install screw and washers and tighten firmly. Place O-ring in body, then install check valve assembly with chamfered edge toward O-ring. Press snap ring into groove in body.

5. Install outlet adapter on side of body, using new gasket, and attach with four bolts and lock washers. Tighten bolts firmly.

FRONT BRAKE LIMITING VALVE AND TWO-WAY CONTROL VALVE

A combination limiting and quick release valve (fig. 15) and a two-way control valve (fig.16) are used in combination on some vehicles as typically illustrated in figure 14. This combination permits full brake delivery pressure to the front brakes when on dry roads, or at the option of the operator, limits the pressure to the front brakes to 50 percent of the brake valve delivery pressure when on slippery roads.

The two-way control valve is mounted on instrument panel within easy reach of the driver. The limiting quick release valve is mounted on bulkhead above front axle in place of the standard

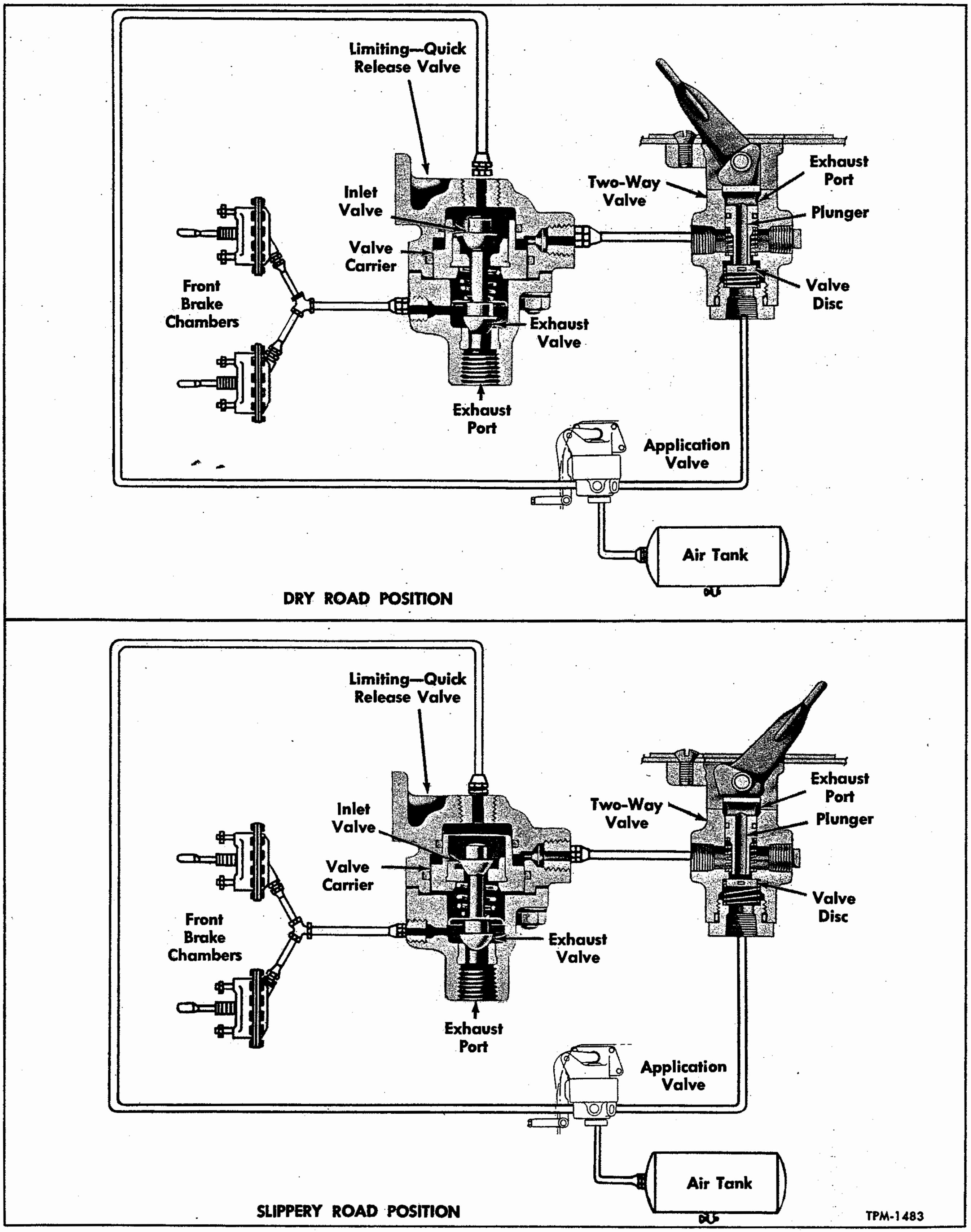


Figure 14—Front Brake Limiting and Two-Way Control Valve Operation

tee fitting. One air line from the brake application valve is connected to the inlet port of the two-way valve and another connects to the brake valve port at top of limiting quick release valve (fig. 14). Another air line connects the side delivery port of the two-way valve to the port opposite the mounting pad of the limiting quick release valve. The two other side ports of the limiting quick release valve are connected to the front brake chambers (fig. 14).

The limiting quick release valve, beside providing for a 50 percent reduction of front wheel brake pressure, also serves as a quick release valve when brakes are released.

OPERATION

1. Dry Roads (Top View, Fig. 14)

a. When the handle of the two-way valve is placed in the "DRY ROAD" position, the hollow plunger of the valve is depressed and contacts the inlet valve assembly, unseating the valve. In this position, air passage through the hollow plunger is closed and air pressure from the application valve has free passage through the two-way valve to the front port of the limiting quick release valve.

b. When brakes are applied, air pressure from the brake application valve enters the limiting quick release valve at the top. This air pressure, acting on the upper inner surface of the valve carrier, forces the carrier down until the exhaust valve contacts the valve seat in the valve cover, closing the exhaust port. The carrier still continues to move downward, partially opening the inlet valve.

c. At the same time, the pressure from the application valve passes through the two-way valve as explained in a above, and enters the limiting quick release valve at the side. With the valve carrier already partially depressed, the air pressure coming from the two-way valve acts on the larger outer surface of the valve carrier and forces the carrier down still further to the limit of its travel. This action moves the carrier fully away from the inlet valve, permitting full application valve pressure to be delivered to the front brake chambers.

2. Slippery Roads (Bottom View, Fig. 14)

a. When the handle of the two-way valve is placed in "SLIPPERY ROAD" position, the hollow plunger is raised by the plunger spring and the inlet-exhaust valve assembly is held closed by the inlet valve spring. Any air pressure in the line connecting the limiting quick release valve and the two-way valve will be exhausted through the hollow plunger and exhaust port of the two-way valve.

b. When the brake application valve is applied with the two-way valve in slippery road position, the air pressure from the brake application valve is stopped at the inlet valve of the two-way valve and does not enter the side port of the limiting quick release valve. At the same time, however, air pressure from the application valve enters the limiting quick release valve at the top. This pressure, acting on the upper inner surface of the valve carrier, forces the carrier down until the exhaust valve closes the exhaust port and partially opens the inlet valve. Air pressure passing by the inlet valve and building up in the brake chambers is acting on the lower surface of the valve carrier. The lower surface of the valve carrier is approximately twice as large as the upper inner surface, therefore, when the pressure acting on the lower surface of the carrier is approximately one-half the application valve delivery pressure, the valve carrier moves up and closes the inlet valve, and the exhaust valve will remain closed. The limiting quick release valve is then in a position where the pressure in the lower portion of the valve and in the brake chambers will be approximately one-half the pressure being delivered to the upper portion of the valve by the application valve.

SERVICEABILITY TESTS

1. Operating Tests

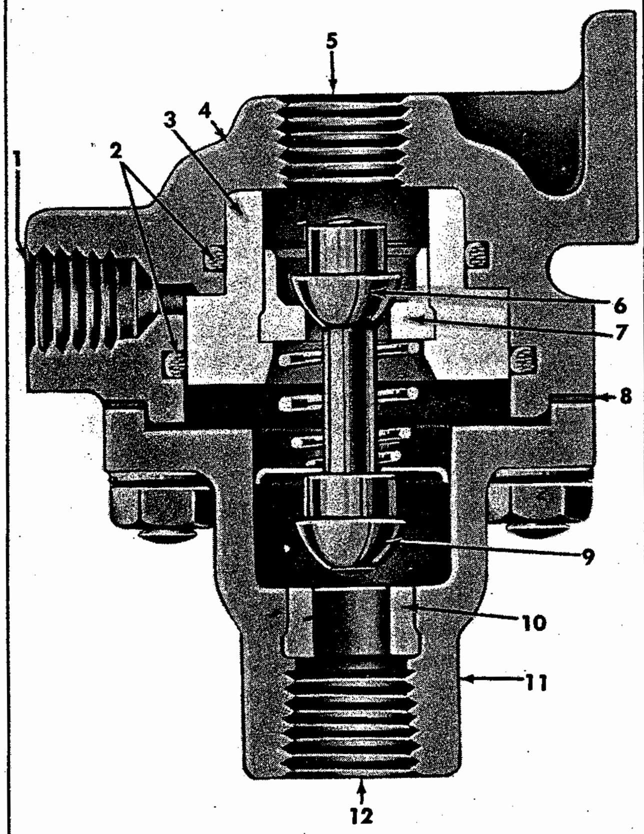
a. Install an air pressure test gauge in application valve delivery line. A convenient method of connecting gauge is to remove stop light switch at front of application valve and connect gauge to stop light switch fitting. Disconnect one front brake chamber line from port at side of limiting quick release valve and connect another test gauge to this port.

b. Place the handle of the two-way valve in the "DRY ROAD" position and apply the brakes. Both test gauges should read the same. Place the handle of the two-way valve in the "SLIPPERY ROAD" position and apply the brakes. The test gauge at the limiting quick release valve should read approximately one-half the amount shown on the test gauge connected to the application valve delivery line.

2. Leakage Tests

a. Place the handle of the two-way valve in "DRY ROAD" position and with the brakes applied, coat the exhaust ports of the two-way valve and limiting quick release valve with soap suds. Leakage at either port should not exceed a one-inch soap bubble in one second.

b. Place the handle of the two-way valve in the "SLIPPERY ROAD" position and with the brakes applied, coat the exhaust port of the two-way valve with soap suds. Leakage should not exceed a one-inch bubble in one second.



1 Inlet Port From Two-Way Valve	6 Inlet Valve
2 Grommets	7 Inlet Valve Seat
3 Valve Carrier	8 Gasket
4 Valve Body	9 Exhaust Valve
5 Inlet Port From Application Valve	10 Exhaust Valve Seat
	11 Valve Cover
	12 Exhaust Port

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Figure 15—Front Brake Limiting Quick Release Valve

LIMITING VALVE OVERHAUL (Fig. 15)

1. Disassembly

a. Remove nuts and lock washers from studs securing valve cover to valve body. Separate cover and body and discard gasket.

b. Push valve carrier with inlet and exhaust valve assembly out of valve body. Remove O-rings from grooves in valve body.

2. Cleaning, Inspection, and Repair

Wash all metal parts in cleaning solvent. Examine body and cover for cracks or other damage. Inspect exhaust valve seat in cover; if seat is nicked, chipped, or worn, replace cover. Remove slight scratches or scores from inner surface of body with crocus cloth. If any part of the valve carrier and inlet and exhaust valve assembly is scratched, nicked, chipped, or worn, the complete assembly must be replaced.

3. Assembly

a. Install new O-rings in grooves in valve body, then place valve carrier assembly in body.

b. Place new gasket on body, then install cover, making sure valve guide enters bore in cover. Install nuts and lock washers on cover-to-body studs and tighten firmly.

c. After installing valve in vehicle, or using a test hook-up, test valve as previously directed under "Serviceability Tests."

TWO-WAY VALVE OVERHAUL (Fig. 16)

1. Disassembly

a. Using a small drift, drive out fulcrum pin securing control lever in valve body and remove lever.

b. Remove cap nut, O-ring, valve spring, and valve disc from bottom of body.

c. Push against bottom of valve plunger to remove plunger from top of body. Remove plunger spring from body and remove O-ring from plunger.

2. Cleaning and Inspection

Wash all metal parts in cleaning fluid. Carefully examine small end of plunger which contacts valve; if any roughness or damage is evident, replace plunger. Inspect valve seat in body; if seat shows wear or damage, replace body. Replace valve disc if any wear or damage is evident. Replace valve spring if weakened by rust or corrosion.

3. Assembly

a. Install new O-ring in groove in plunger and on cap nut. Coat plunger with Lubriplate, place spring on small end of plunger, and install plunger and spring in top of body.

b. Install control lever in body and secure with fulcrum pin. Stake pin in place.

c. Turn body bottom side up and install valve disc, valve spring, and cap nut, being sure new O-ring is in place on cap nut. Tighten cap nut firmly.

d. After installing valve in vehicle, or using a test hook-up, test valve as previously directed under "Serviceability Tests."

I.C.C. BRAKE VALVE

I.C.C. (Interstate Commerce Commission) brake valve is provided as an emergency method for applying the air brakes on rear axle. Valve is mounted at right side of driver. Valve control lever should remain in "NORMAL" position at all times during normal operation. When lever is moved to "EMERGENCY" position, full air pressure is applied to brakes on rear axle only.

IMPORTANT: Valve should be tested at regular intervals to make sure it is operating properly.

The I.C.C. valve and the two-way control valve shown in figure 16 are identical. The following key numbers refer to figure 16. This valve is in "NORMAL" position, with plunger (14) raised and valve disc (7) against valve seat in body. Air supply line from front air tank is connected to inlet port (11) in cap nut (10). Outlet line to rear brake relay valve is connected to outlet port (12).

When control lever (4) is moved to "EMERGENCY" position, cam on lever forces plunger down. Lower end of plunger seats against valve disc (7) closing exhaust passage through plunger, and forcing valve disc off seat in body. This permits full air pressure to flow past valve disc into line leading to rear brake relay valve. With full air pressure applied to relay valve, relay valve delivers full pressure to brakes on rear axle. At the same time, air pressure being delivered to relay valve enters top of air pressure cut-off valve, cutting off flow of air pressure to brake application valve and auxiliary air system. Refer to "Air Pressure Cut-off Valve" later.

When valve control lever is returned to "NORMAL" position, plunger spring raises plunger, permitting valve spring to seat valve disc against seat in body, shutting off flow of air pressure. Air pressure which has been let into line leading to relay valve is exhausted through the hollow plunger, permitting relay valve to exhaust air pressure from rear brakes.

Refer to "TWO-WAY VALVE OVERHAUL" for information on the disassembly, cleaning and inspection, and assembly of I.C.C. valve.

AIR PRESSURE CUT-OFF VALVE

Air pressure cut-off valve (fig. 17) is installed in air line from front air tank supplying air pressure to brake application valve and auxiliary air system, and is also connected to the outlet side of the I.C.C. brake valve. Normally, air pressure from air tank lifts diaphragm in cut-off valve and flows through valve to brake application valve and auxiliary air system. When I.C.C. brake valve control lever is moved to "EMERGENCY" position, air pressure from I.C.C. brake valve, flowing to rear brake relay valve, at the same time enters cut-off valve above the diaphragm. Combined force of air pressure and spring above diaphragm overcomes force of air pressure below diaphragm and forces diaphragm down, cutting off flow of air pressure to application valve and auxiliary air system.

Air cut-off valve is located in tool and inspection compartment at right of brake application valve. Arrows on top of valve body indicate normal direction of air flow through the valve.

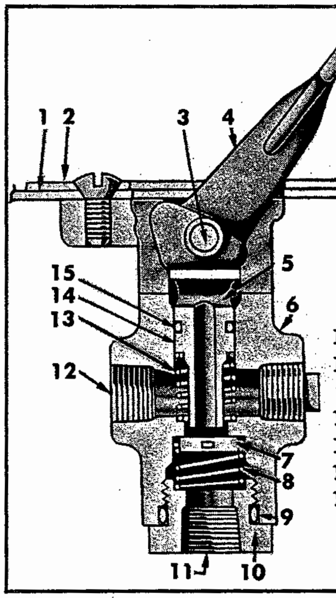


Figure 16—Two-Way Control Valve (Also I.C.C. Valve)

DISASSEMBLY (Fig. 17)

Remove four screws attaching cover to body. Remove cover, spring, spring seat, and diaphragms.

CLEANING AND INSPECTION (Fig. 17)

Clean all parts thoroughly. Examine diaphragms; if any signs of cracking or deterioration are evident, replace with new diaphragms. Make sure diaphragm seat in body is clean and smooth. Bore in cover must be clean and smooth to permit free movement of spring seat. If spring has been weakened by rust or corrosion, replace with new spring.

ASSEMBLY (Fig. 17)

Lubricate bore in cover contacted by spring seat. Place diaphragms on body. Place spring and spring seat in cover and position cover on diaphragms and body. Install four screws and tighten securely.

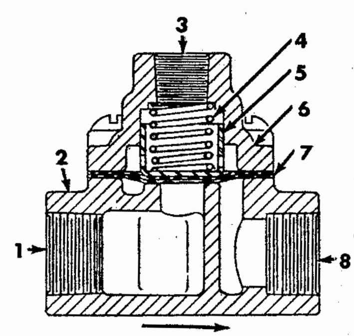


Figure 17—Air Pressure Cut-Off Valve

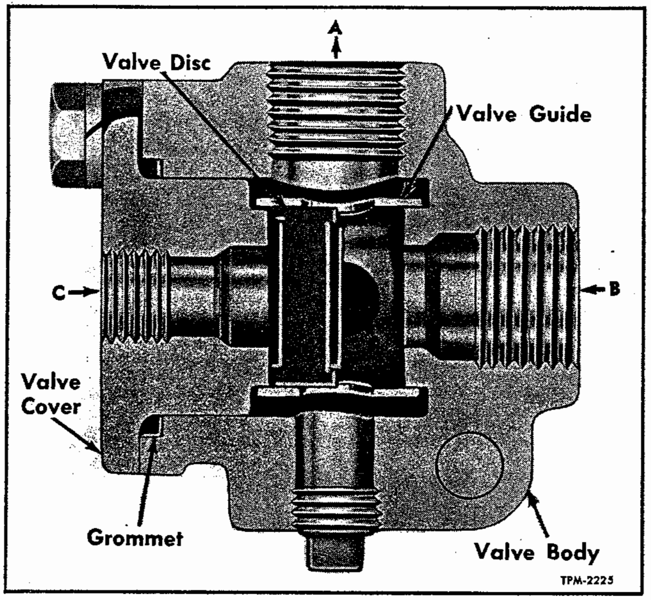


Figure 18—Double Check Valve

DOUBLE CHECK VALVE

Double check valve (fig. 18) is installed in air line between I.C.C. valve and brake application valve. Valve is located in tool and inspection compartment at right of brake application valve.

When foot brake is applied, air pressure from application valve enters the check valve at port "B." This air pressure forces valve disc against port "C," and passes out port "A" to rear brake relay valve and rear brakes are applied.

When I.C.C. brake valve lever is placed in "EMERGENCY" position, air pressure direct from front air tank passes through I.C.C. brake valve and enters check valve at port "C." This air pressure forces valve disc against port "B," passes out port "A" to the rear brake relay valve, and rear brakes are applied.

CHECK VALVE OVERHAUL (Fig. 18)

1. Disassembly

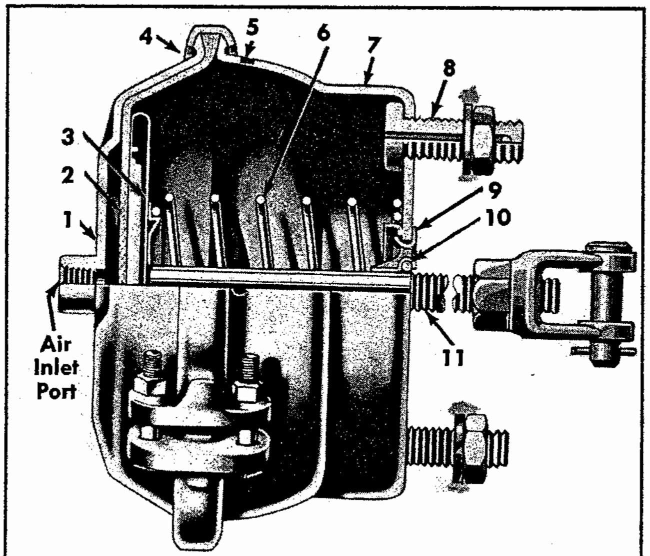
Remove two cap screws and lock washers attaching valve cover to body. Remove cover and grommet, then remove valve disc and valve guide.

2. Inspection

Wash all parts in a cleaning solution and wipe dry. Examine all parts for corrosion or deterioration and replace as necessary. Make sure valve disc will slide freely back and forth in valve guide.

3. Assembly

Place valve guide and valve disc in body. Install new grommet on valve cover; then position cover on body. Install cover cap screws and lock washers, and tighten evenly and firmly.



1 Pressure Plate	7 Non-Pressure Plate
2 Diaphragm	8 Breather Stud
3 Spring Guide	9 Push Rod Seal Retainer
4 Clamping Ring	10 O-Ring
5 Drain Hole	11 Push Rod
6 Return Spring	TPM-5319

Figure 19—Brake Chamber

BRAKE CHAMBERS

An air brake chamber (fig. 19) is mounted at each wheel as shown in figures 21 and 22. Brake chambers are connected to air system through the brake application valve and rear brake relay valve.

The purpose of the brake chambers is to convert the energy of compressed air into the mechanical force and motion necessary to operate the mechanical brake assembly at each wheel. Brake chamber consists essentially of a pressure plate, non-pressure plate, diaphragm, push rod, push rod seal, and spring. The push rod is connected to a slack adjuster, mounted on brake camshaft.

One of the mounting studs on each brake chamber is drilled as shown in figure 19 to provide breathing on non-pressure side of diaphragm.

BRAKE CHAMBER SERVICEABILITY TESTS

1. Operating Test

Apply brakes and see that the brake chamber push rods move out promptly without binding. Release brakes and see that they return to released position promptly without binding.

2. Leakage Tests

a. With brakes fully applied, coat the edges of the clamp ring holding the diaphragm in place

with soap suds to check for leakage. No leakage is permissible. If leaking, tighten clamp ring bolts.

b. With brakes fully applied, check for leakage through the diaphragm by applying soap suds to breather holes in mounting stud and to push rod next to non-pressure plate. No leakage is permissible. If leakage is found, replace diaphragm.

BRAKE CHAMBER REPLACEMENT

1. Removal (Fig. 21 or 22)

a. Disconnect hose from brake chamber as follows: At front, hold hose union nut with wrench while turning connector out of elbow in brake chamber. At rear, hold connector body (threaded into elbow) while turning nut (next to spring guard). Spring will turn on hose while unscrewing connector nut from body. Pull hose off tube on connector body. If new brake chamber is to be installed, remove connector body and elbow (rear) or elbow (front) for installation on replacement unit.

b. Disconnect push rod yoke from slack adjuster.

c. Remove nuts and lock washers from two mounting studs, then remove brake chamber assembly from bracket.

2. Installation (Fig. 21 or 22)

a. Position brake chamber at bracket, with mounting studs through holes in bracket. Install lock washer and nut on each stud and tighten firmly.

b. Install elbow (front) or elbow and connector body (rear) in brake chamber. Elbow must point up when fully tightened.

c. Connect hose to elbow as follows: At front, thread connector into elbow and tighten firmly while holding hose union nut with wrench. At rear, push hose firmly onto tube on connector body, then thread hose nut onto connector body. Tighten firmly.

d. Connect brake chamber push rod yoke to slack adjuster. Adjust brakes as previously directed under "Brake Adjustments." Apply brakes and make sure push rods are correct length. Angle formed by push rod and slack adjuster should be more than 90 degrees, and should still be slightly greater than 90 degrees with brakes applied. In other words, the slack adjuster should not go "over center" when brakes are applied. If necessary, adjust push rod length by turning yoke onto or off push rod. Push rod must not extend through yoke far enough to interfere with slack adjuster. Test brake chamber as previously directed under "Serviceability Tests."

BRAKE CHAMBER DISASSEMBLY (Fig. 19)

1. Before disassembling brake chamber, mark the non-pressure plate and pressure plate with relation to the clamp ring so the bolts of the clamp ring will be at the same location when reassembled. This will eliminate the possibility of installation interference when brake chamber is installed.

2. Pull out push rod and clamp it at the non-pressure plate, using a vise or vise-grip pliers. This will relieve tension of spring on diaphragm and clamp ring.

3. Remove nuts from two clamp ring bolts and remove bolts. Spread clamp ring and remove from plates, then remove pressure plate and diaphragm.

4. Remove yoke and lock nut from push rod. Release clamp from push rod, then remove push rod, push rod spring and spring guide from non-pressure plate. Remove O-ring seal from seal retainer.

CLEANING AND INSPECTION

1. Clean all metal parts thoroughly, using suitable cleaning fluid. Prod drilled breather hole in mounting stud to make sure it is open.

2. Examine diaphragm and replace with new part if any signs of wear or deterioration are evident. Diaphragms should be replaced every 50,000 miles, or once a year regardless of condition.

3. Examine push rod and spring guide for distortion. Replace with new part if damaged.

4. Examine push rod spring and replace if weak or broken. When replacing push rod spring, make sure it has the same tension as the spring in brake chamber on opposite wheel, otherwise unbalanced braking may result.

5. Replace push rod O-ring seal. Apply thin coat of lubriplate to O-ring before installing.

6. Replace pressure plate or non-pressure plate is distorted or if any damage at the clamping flange is evident.

BRAKE CHAMBER ASSEMBLY (Fig. 19)

1. Rest push rod upright on a flat surface. Install spring guide, push rod spring, push rod seal, and non-pressure plate over push rod. Press non-pressure plate down, compressing the springs, until it rests on the flat surface. Install vise-grip pliers or similar tool on push rod at non-pressure plate to hold springs compressed.

2. Place clamp ring over the clamping flange of the non-pressure plate, aligning marks made prior to disassembly.

3. Position diaphragm in pressure plate. Place pressure plate and diaphragm on the non-pressure plate, working the clamp ring over the diaphragm bead and clamping flange of pressure plate. Marks on pressure plate, clamp ring, and non-pressure plate must be aligned.

4. Using vise-grip pliers or C-clamp on one side of lugs on clamp ring, draw clamp ring together and install one bolt and nut. Remove tool and install the other bolt and nut. Tighten clamp ring bolts just enough to form an air-tight seal.

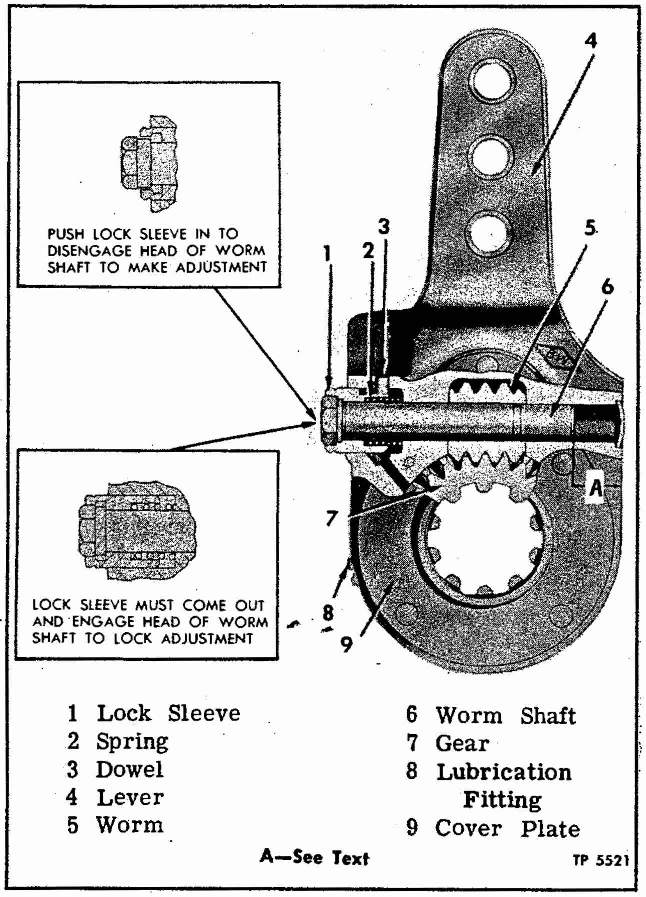


Figure 20—Slack Adjuster

SLACK ADJUSTERS

Slack adjusters function as adjustable levers and provide a quick and easy method of adjusting the brakes to compensate for normal lining wear. Positive locking type slack adjusters are used at front and rear brakes. Construction of both front and rear slack adjusters is as shown in figure 20. Front and rear slack adjuster installations are shown in figures 21 and 22.

Slack adjuster consists basically of a hardened steel gear, which is splined to the brake camshaft, a brake lever (body), and hardened steel worm which is mounted in the lever above the gear and meshes with the teeth in the gear. Turning the worm shaft causes rotation of the camshaft in relation to the brake lever. During brake operation the entire slack adjuster rotates bodily with the camshaft. As the brake chamber push rod reaches its maximum travel due to normal lining wear, turning worm shaft rotates lever back to original setting.

SLACK ADJUSTER SERVICEABILITY TEST

Adjust brakes as previously directed under "Brake Adjustment" in this section, then carefully measure brake chamber push rod travel as brakes are applied. Make several full brake applications and again measure push rod travel. Push rod travel should be the same as it was immediately after adjustment. If push rod travel increases, or if difficulty is experienced in keeping the brakes adjusted in service, the slack adjuster must be overhauled or replaced.

SLACK ADJUSTER REPLACEMENT

Removal (Fig. 21 or 22)

1. Remove clevis pin attaching slack adjuster to brake chamber push rod.
2. Remove snap ring (front) or bolt and washers (rear) securing slack adjuster on camshaft. Slide slack adjuster off end of shaft.

Installation (Fig. 21 or 22)

1. If a new slack adjuster is being installed, make sure it is the same size and type as the one removed. Slide slack adjuster onto camshaft and attach with bolt and washers (rear) or with snap ring (front).
2. Connect brake chamber push rod to slack adjuster, using clevis pin and cotter pin.
3. Lubricate slack adjuster as directed in LUBRICATION (SEC. 13).
4. Adjust brakes as previously directed under "Brake Adjustments."

SLACK ADJUSTER DISASSEMBLY (Fig. 20)

1. Remove dirt and grease from outside of unit by washing in a suitable cleaning fluid.
2. Cut off riveted ends of rivets attaching cover plates to body. Drive out rivets and remove cover plates.
3. Remove welch plug from end of worm shaft bore. Insert a flat end punch into the worm shaft bore and drive worm shaft out of body and worm.
4. Remove lock sleeve and spring from worm shaft. Remove gear and worm from slack adjuster body. Remove lubrication fitting.

INSPECTION AND REPAIR

1. Wash parts in cleaning fluid and wipe dry.
2. Inspect worm and gear and replace with new parts if chipped or broken teeth are evident.
3. Inspect worm shaft for wear. Make sure corners on hex end are not rounded.
4. Inspect bushing in lever arm. If worn, out-of-round, or otherwise damage, it must be replaced. To replace bushing, press old bushing out and press new bushing into place. Bushing must be reamed after installation to 0.501"-0.503".
5. Examine lock sleeve for cracks or other damage. Replace if necessary.
6. Examine lever (body) for cracks or distortion. If lever is damaged in any way, a new body and bushing assembly must be used.

SLACK ADJUSTER ASSEMBLY (Fig. 20)

1. Place worm and gear assembly in position in body.

2. Place lock sleeve over worm shaft, with socket-like end of sleeve at hex end of shaft. Place lock spring in recess formed by sleeve and shaft.

3. Enter small end of worm shaft through hole in body and worm. Press worm shaft into worm and body, making sure the groove in lock sleeve is aligned with pin in body. Press shaft in until distance from small end of shaft to edge of body (A, fig. 20) is 9/16". Install welch plug in worm shaft bore.

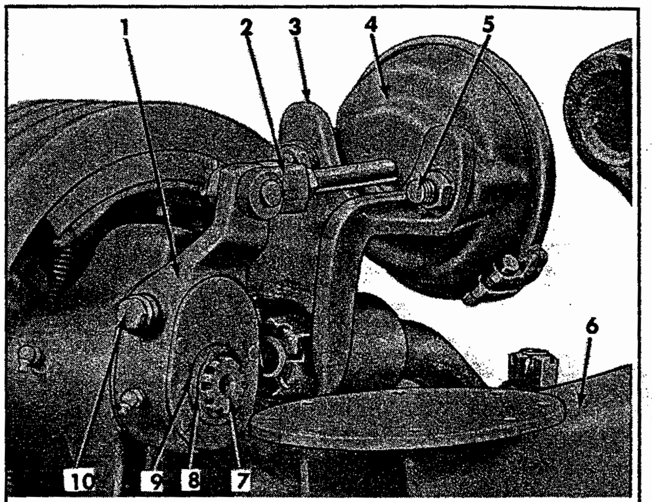
4. Position cover plates on body and attach with new rivets. Covers must be flat and in good contact with body after riveting.

5. Install lubrication fitting in body. Connect a grease gun to fitting and force grease into slack adjuster until it is completely filled. Refer to LUBRICATION (SEC. 13) for type of lubricant.

FRONT BRAKE SHOES, LININGS, AND CAMSHAFTS

SHOES AND LININGS

Brakes at each front wheel have two shoes which pivot on anchor pins at one end and are ex-



1 Slack Adjuster
2 Push Rod Yoke
3 Brake Chamber Bracket
4 Brake Chamber
5 Brake Chamber Mounting Stud
6 Suspension Support
7 Camshaft
8 Snap Ring
9 Washer
10 Slack Adjuster Worm Shaft

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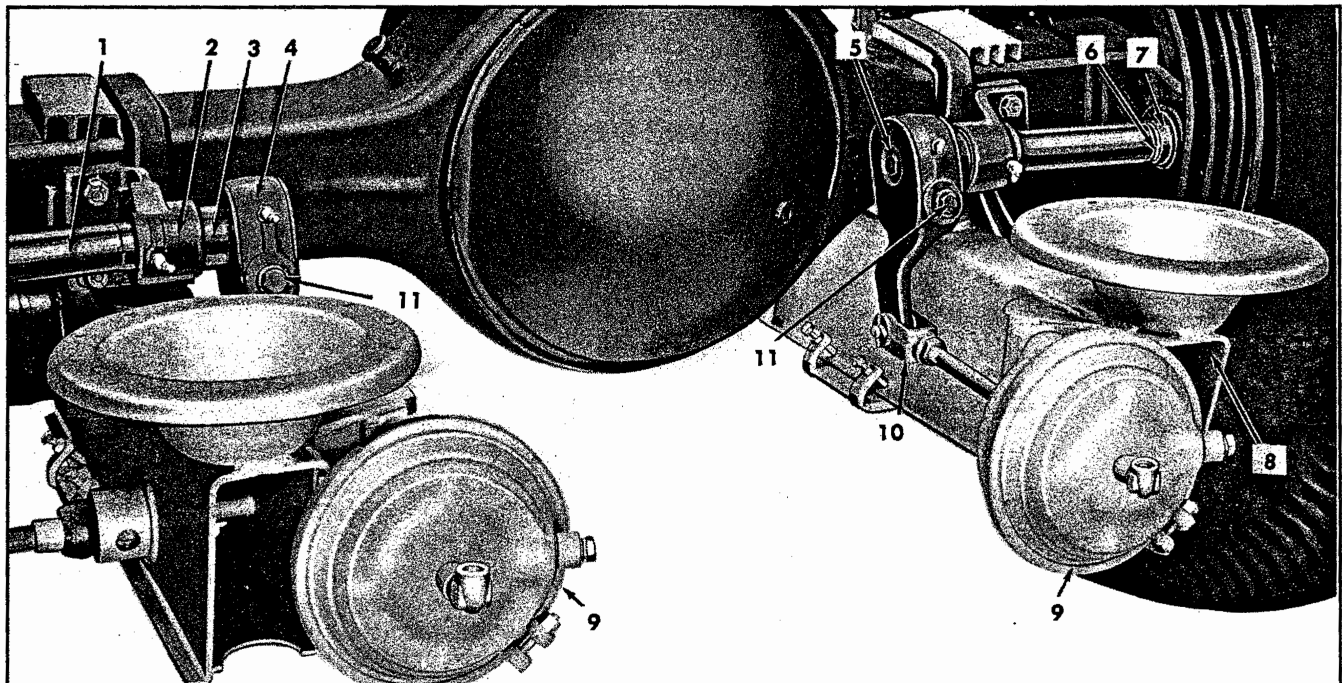
Figure 21—Front Brake Camshaft, Bracket, and Slack Adjuster Assembled to Axle



1 Brake Camshaft
2 Camshaft Support Bracket
3 Spacer
4 Slack Adjuster
5 Slack Adjuster Retaining Bolt
6 Snap Ring
7 Spacing Washers
8 Suspension Support
9 Brake Chamber
10 Push RodYoke
11 Slack Adjuster Worm

TPM 5322

Figure 22—Rear Brake Camshaft, Slack Adjuster, and Camshafts Assembled to Axle

panded at the other end during brake application by constant lift S-type cams. Brake shoe return springs hold shoe ends firmly against cam. Two-piece block type lining is bolted to each shoe. Holes through lining and upper shoe at cam end are provided to facilitate removing and installing springs.

Cam end of each shoe is equipped with a roller which acts as contact between shoe and cam. Roller shaft is integral with roller and rides in a groove at toe end of shoe web. Shoe return springs hold roller securely between cam and toe of shoe.

ANCHOR PINS

Anchor pin end of each shoe fits between brackets at brake spider, and is retained by straight type anchor pin (fig. 24). Both anchor pins are held in place by a lock plate which engages notches in end of each pin and is attached to brake spider by a cap screw.

CAMSHAFTS

Front brake camshafts are mounted in needle type roller bearings in brake spider (fig. 23). Lubrication fitting in spider provides method of lubricating bearing. Lubricant is retained by seals which are pressed into spider.

FRONT BRAKE SHOE AND CAMSHAFT REMOVAL

1. Jack up axle and remove wheel and brake drum. Remove hub as directed in "HUBS AND BEARINGS" (SEC. 19).

2. Drive plugs out of lining at cam end of upper shoe, using a punch through holes in shoe. Using a hooked tool through holes in lining and shoe, unhook springs from pin in upper shoe. Remove springs from pin in lower shoe. Tag or mark shoes so they may be reinstalled in their original position.

3. Remove anchor pin lock plate. Drive anchor pins out of brake spider and shoes, then remove brake shoes.

4. To remove camshaft, (fig. 23), disconnect brake chamber push rod yoke from slack adjuster. Remove snap ring and washer securing slack adjuster on camshaft and pull slack adjuster off end of shaft. Pull camshaft out of brake spider, stripping spacing washers off shaft as shaft is removed.

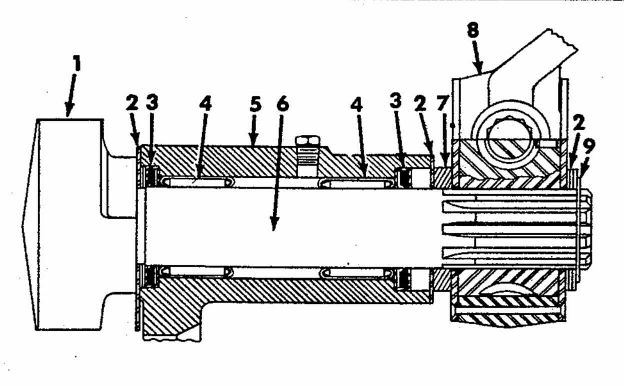


Figure 23—Front Brake Camshaft and Slack Adjuster Mounting

INSPECTION

1. Wash all parts except shoe and lining assemblies in cleaning solvent. Check anchor pins for wear in accordance with dimensions listed in "Specifications" at end of this group. Replace with new parts any that are excessively worn.

2. Examine camshaft needle bearings and seals. If there is any indication of wear or distortion, remove old parts and replace with new. When installing new needle bearings, carefully drive into place with suitable driver, driving on end of cage bearing the manufacturer's stamping. New seals should be soaked in oil until soft and pliable before installing, and should be installed with tapered edge toward cam. With lips of seals in this position, seal toward slack adjuster will provide pressure relief. Otherwise grease pressure will force lips of both seals against camshaft and sufficient pressure can build up to lock camshaft. Also, camshaft can be more easily installed without damage to seals when seals are installed with tapered edge toward cam.

3. Check fit of rollers in shoes. If excessive looseness is evident, remove rollers and check for wear. Replace worn parts.

4. Check tension of brake shoe return springs. Replace if weak or broken.

5. Check thickness of brake lining at center of shoe. If worn down to 5/16" thickness, lining must be replaced. When replacing linings, lining with return spring access holes must be installed at cam end of upper shoe. Linings must be securely bolted to shoes. New lock washers should be used and nuts tightened to 20-25 foot pounds torque. A 0.006" feeler must not enter between shoe and lining at any point. Drive lining plugs into bolt holes in lining when installation is completed. Make sure roller in shoe is standard size when new linings are installed.

6. Examine camshaft for cracks, distortion, or wear at the bearing surfaces. Replace if worn or damaged.

7. If brake drums have been machined oversize, refer to instructions under "Brake Drums" later in this section.

FRONT CAMSHAFT AND
BRAKE SHOE INSTALLATION

1. Work lubricant into camshaft bearings. Refer to LUBRICATION (SEC. 13) for type lubricant.

2. Install large spacing washer on camshaft and insert camshaft through bearings in spider (fig. 23), being careful not to damage seals.

3. Install brake shoes at brake spider in same position from which they were removed. Insert anchor pins through brake spider and shoes. Turn anchor pins so notches in inner end face each other. Install anchor pin lock plate and secure with cap screw and lock washer (fig. 24).

4. Hook one end of brake shoe return springs on pin in lower brake shoe. Stretch springs and hook onto pin in upper shoe, using hooked tool through holes in lining and shoe. Drive lining plugs into holes after hooking springs.

5. Place spacing washer and spacer over inner end of camshaft (fig. 23), install slack adjuster on camshaft, and secure with washers and snap ring. Connect brake chamber push rod yoke to slack adjuster, using clevis pin and cotter pin. Back off slack adjuster worm shaft until shoe rollers rest on lowest points on cam.

6. Install hub, drum, and wheel, and adjust bearings as directed in "HUBS AND BEARINGS" (SEC. 19).

7. Adjust brakes as previously directed under "Brake Adjustment" in this section.

8. Lubricate camshaft bearings as directed in LUBRICATION (SEC. 13).

REAR BRAKE SHOES, LININGS, AND CAMSHAFTS

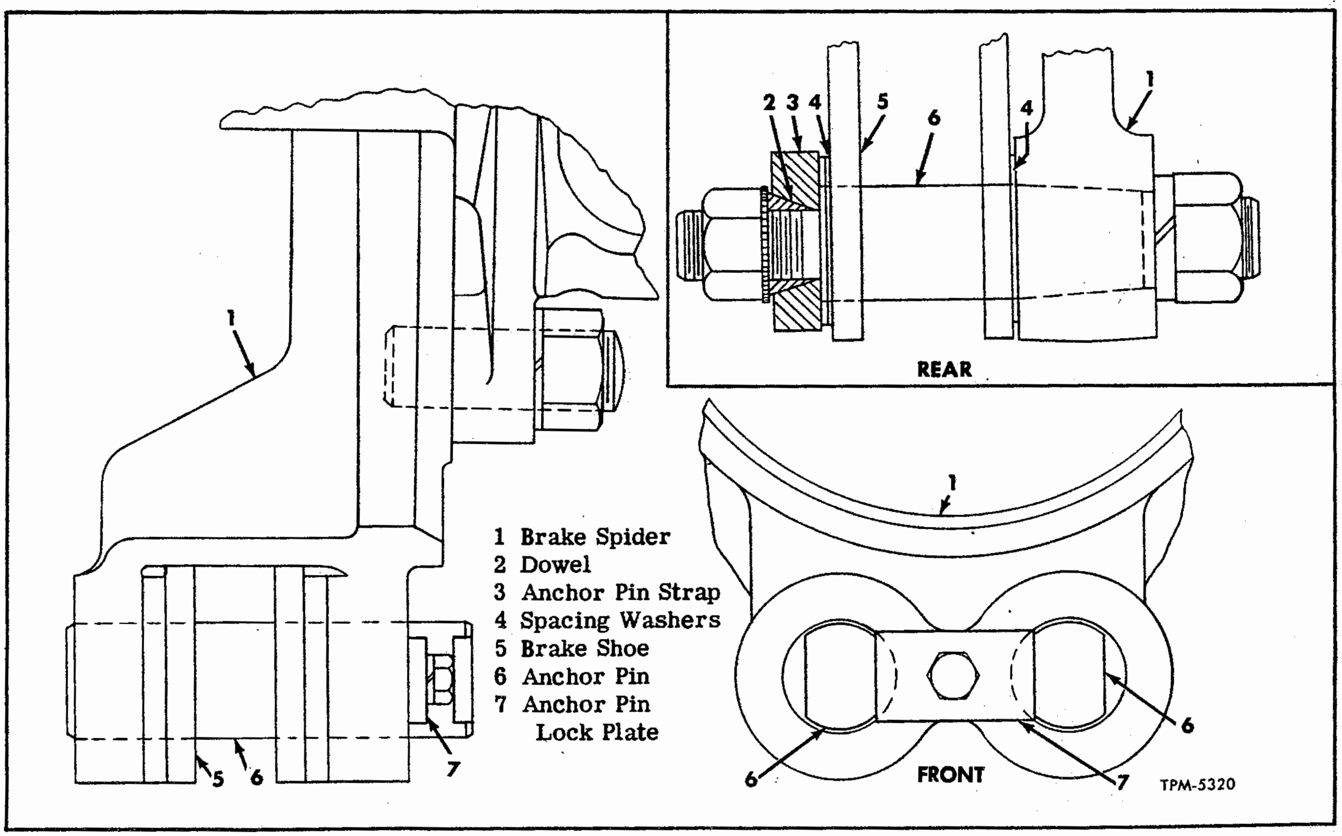
SHOES AND LININGS

Brakes at each rear wheel have two shoes which pivot on anchor pins at one end and are expanded at the other end during brake application by constant lift S-type cams. Brake shoe return springs hold shoe ends firmly against cam. Two-piece block type lining is bolted to each shoe. Hole through lining and upper shoe at cam end are provided to facilitate removing and installing springs.

Cam end of each shoe is equipped with a roller which forms the contact between shoe and cam.

ANCHOR PINS

Heel of each brake shoe is carried on anchor pins which are installed in brake spider as shown in figure 24. Shoes are retained on anchor pins by a strap, two tapered dowels, two lock washers, and two nuts. Spacing washers are used as required to provide proper fit of shoe end between spider and strap.



1 Brake Spider
2 Dowel
3 Anchor Pin Strap
4 Spacing Washers
5 Brake Shoe
6 Anchor Pin
7 Anchor Pin Lock Plate

Figure 24—Front and Rear Brake Shoe Anchor Pins Installed

CAMSHAFTS

Inner end of each camshaft is carried in needle bearing in camshaft support (fig. 25). This camshaft support is attached to axle housing by two bolts and lock washers. An O-ring seal is placed at both sides of needle bearing. Outer end of camshaft is carried in needle bearing in brake spider (fig. 25). Oil seals are pressed into spider at each end of bearing. Lubrication fitting in camshaft support and in brake spider provide means of lubricating bearings. Camshaft is held in position by a snap ring at the brake spider.

REAR BRAKE SHOE REMOVAL

1. Jack up axle and remove wheels and brake drum. Remove hub as directed in "HUBS AND BEARINGS" (SEC. 19).

2. Drive plugs out of lining at cam end of upper shoe, using a punch through holes in shoe. Using a hooked tool through holes in lining and shoe, unhook springs from pin in upper shoe. Remove springs from pin in lower shoe.

3. Tag or mark shoes so they may be reinstalled in their original position. Remove nut and lock washer from each anchor pin, then remove anchor pin strap and spacing washers. Remove brake shoes from anchor pins.

INSPECTION

1. Check anchor pins for wear in accordance with "Specifications" at end of this group. Replace with new parts any that are badly worn.

2. Check fit of rollers in shoes. Replace worn parts.

3. Check tension of brake shoe return springs. Replace if weak or broken.

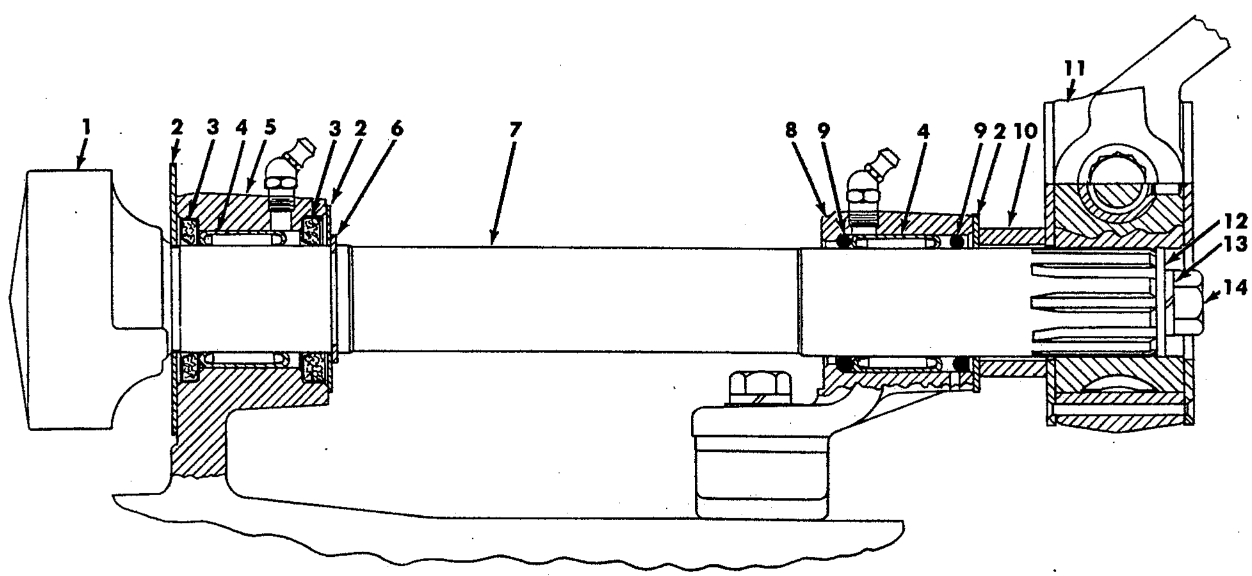
4. Check thickness of brake lining at center of shoe. If worn down to 5/16" thickness, lining must be replaced. When replacing linings, lining with return spring access holes must be installed at cam end of upper shoe. Linings must be securely bolted to shoes. New lock washers should be used and nuts tightened to 20-25 foot-pounds torque. A 0.006" feeler must not enter between lining and shoe at any point. Drive lining plugs into bolt holes in lining when installation is completed. Make sure roller in shoe is standard size when new linings are installed.

5. If brake drums have been machined oversize, refer to instructions under "Brake Drums" later in this section.

REAR BRAKE SHOE INSTALLATION

1. Place spacing washer on each anchor pin. Install brake shoes on anchor pins in same position from which they were removed.

2. Place spacing washers on outer end of



1 Cam (Integral with Shaft)
2 Spacing Washers
3 Oil Seals
4 Needle Bearing
5 Brake Spider
6 Snap Ring
7 Camshaft
8 Camshaft Support Bracket
9 O-rings
10 Spacer
11 Slack Adjuster
12 Flat Washer
13 Lock Washer
14 Bolt

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Figure 25—Rear Brake Camshaft and Slack Adjuster Mounting

anchor pin to take up clearance between shoe ends and anchor pin strap with strap against shoulder on pins (fig. 24). Do not use enough washers to cause shoe to bind when anchor pin nuts are tightened. Install strap, dowels, lock washers, and nuts on anchor pins and tighten firmly. Make sure shoes do not bind on pins.

3. Hook one end of brake shoe return springs on pin in lower brake shoe. Stretch springs and hook onto spring in upper shoe, using hooked tool through holes in lining and shoe. Drive lining plugs into holes after hooking springs.

4. Back off slack adjuster worm shaft until shoe rollers rest on lowest points on cam. Install hub, drum, and wheels as directed in "HUBS AND BEARINGS" (SEC. 19).

5. Adjust brakes as previously directed under "Brake Adjustment" in this section.

REAR CAMSHAFT REMOVAL (Fig. 25)

1. Accomplish steps 1 and 2 under "Rear Brake Shoe Removal." Swing brake shoes outward.

2. Disconnect brake chamber push rod yoke from slack adjuster. Remove bolt, lock washer, and flat washer securing slack adjuster on camshaft. Remove slack adjuster, spacer, and spacing washer from end of camshaft.

3. Remove snap ring from groove in camshaft at inner side of brake spider. Slide snap ring toward inner end of camshaft.

4. Withdraw camshaft from brake spider and support bracket, stripping spacing washers and snap ring off shaft as shaft is removed.

5. Remove two bolts and lock washers attaching camshaft support bracket to axle housing. Remove and discard O-ring seals in support bracket.

INSPECTION

1. Wash all parts in cleaning solvent. Examine needle bearings and seals in brake spider and in support bracket. If there is any indication of wear or distortion, remove old parts and replace with new. When installing new needle bearings, carefully drive into place with suitable driver, driving on end of cage bearing the manufacturer's stamping. Install needle bearing in support bracket far enough to leave 5/16" clearance between bearing and end of bracket toward slack adjuster. Install new O-rings in support bracket. New seals in spider should be soaked in oil until soft and pliable before installing, and should be installed in spider with tapered edge toward cam. With lips of seals in this position, seal toward slack adjuster will provide pressure relief. Otherwise grease pressure will force lips of both seals against camshaft and sufficient pressure can build up to lock camshaft. Also camshaft can be more easily installed without damage to seals when seals are installed with tapered edge toward cam.

2. Examine camshaft for cracks, distortion, or wear at the bearing surfaces. Replace if worn or damaged.

REAR CAMSHAFT INSTALLATION (Fig. 25)

1. Work lubrication into camshaft bearings. Refer to LUBRICATION (SEC. 13) for type of lubricant.

2. Position camshaft support bracket on axle housing and install two bolts and lock washers. Tighten firmly.

3. Place large spacing washer on camshaft, and insert end of camshaft through bearing in brake spider. Place spacing washer and snap ring on camshaft, then carefully insert end of camshaft through bearing and seals in support bracket.

4. Install snap ring in groove in camshaft at inner side of brake spider.

5. Install spacing washer, spacer, and slack adjuster on inner end of camshaft and secure with flat washer, lock washer and bolt. Connect brake chamber push rod yoke to slack adjuster.

6. Accomplish steps 3 and 4 under "Rear Brake Shoe Installation."

7. Adjust brakes as previously directed under "Brake Adjustments." Lubricate camshaft bearings as directed in LUBRICATION (SEC. 13).

BRAKE DRUMS

When brake drums become scored, they may be refaced by machining or grinding. To compensate for increased inside diameter of refaced drums, 1/16" and 1/8" oversize brake linings are available from the lining manufacturers. When drums are refaced, they should be machined in increments of 1/16" (.0625) and linings oversize the amount machined from the drum installed.

Satisfactory operation with oversize linings will be obtained until the lining becomes worn sufficiently to permit the brake shoe roller to pass the high point on the cam without effectively applying the brakes.

NOTE: To avoid misunderstanding the term "oversize" as applied to linings and drums, the following example applies:

1/8" Oversize Brake Drum

Inside diameter (I.D.) of the brake drum has been increased 1/8"; that is 1/16" of metal has been removed around the circumference of the drum.

1/8" Oversize Lining

Linings are 1/16" thicker than standard, thus the total increased thickness of linings on both shoes compensates for the 1/8" increased diameter of drum.

Brake drums should never be machined to more than 1/8" beyond original diameter.

Air Compressor and Governor
(BENDIX—WESTINGHOUSE TU-FLO TYPE)

AIR COMPRESSOR

Standard compressor is a two-cylinder single-acting, reciprocating type unit. Compressor is flange mounted to the gear train cover at the rear end of the engine. Compressor is driven directly from the engine camshaft, and lubricated by the engine lubrication system. The cylinder head and cylinder block are cooled by the engine cooling system. Compressor has a rated capacity of 12 cu. ft. per minute based on piston displacement when running at a speed of 1250 rpm.

COMPRESSOR DRIVE AND LUBRICATION

A hub with internal fiber teeth is keyed to the front end of the compressor crankshaft and secured by a nut and cotter pin (fig. 26). An internal-toothed fiber drive disc is attached to the engine camshaft gear by four cap screws. A drive coupling with external teeth at each end is carried in the internal teeth of the hub and drive disc, transmitting power from drive disc to the air compressor crankshaft hub.

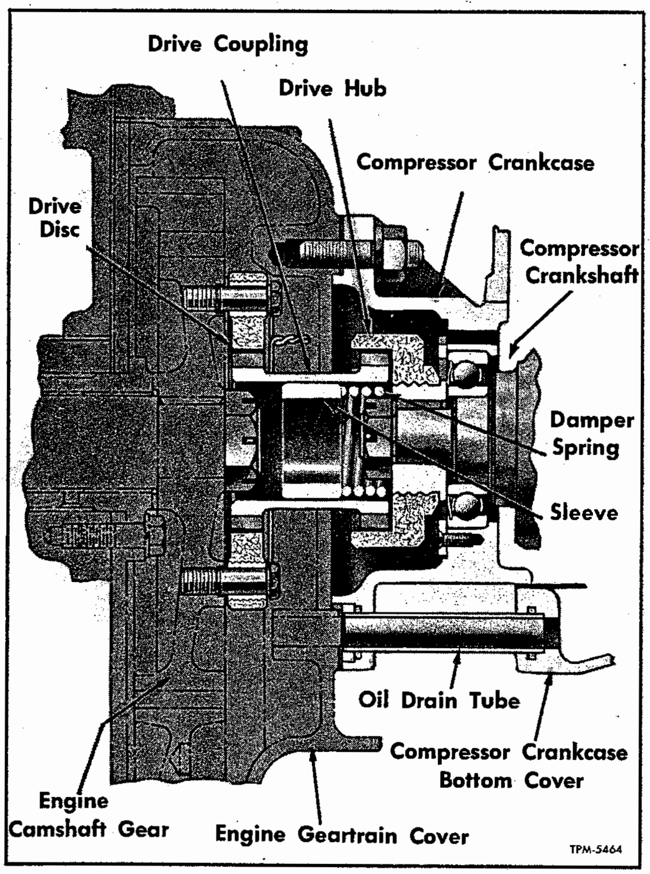


Figure 26—Air Compressor Drive and Oil Return

Oil, under pressure from the engine lubrication system, enters drilled crankshaft through crankshaft rear end cover and is forced through the crankshaft and drilled connecting rods (fig. 27), lubricating bearings, piston pins, and pistons. An oil return tube (fig. 26) connects the compressor crankcase bottom cover to openings in the mounting flange and engine gear train cover. Oil drains from the crankcase bottom cover into the engine gear train cover, and then into the engine crankcase.

Two vent holes through the crankcase above the crankshaft front bearing permit equalization of the compressor crankcase pressure with the engine crankcase pressure.

COMPRESSOR AIR INTAKE

Air compressor has forced air intake system. Compressor air inlet manifold is connected by a tube to the left rear hand-hole cover on the engine air box. When each compressor piston is on down stroke air pressure from engine air box opens compressor inlet valve and forces air into cylinder. This tends to supercharge the compressor, since a greater volume of air flows into the compressor cylinders than when the conventional atmospheric air intake system is used. The use of this type of air intake system also eliminates the necessity of an air compressor air cleaner, since the air in the engine air box is cleaned by the engine air cleaners.

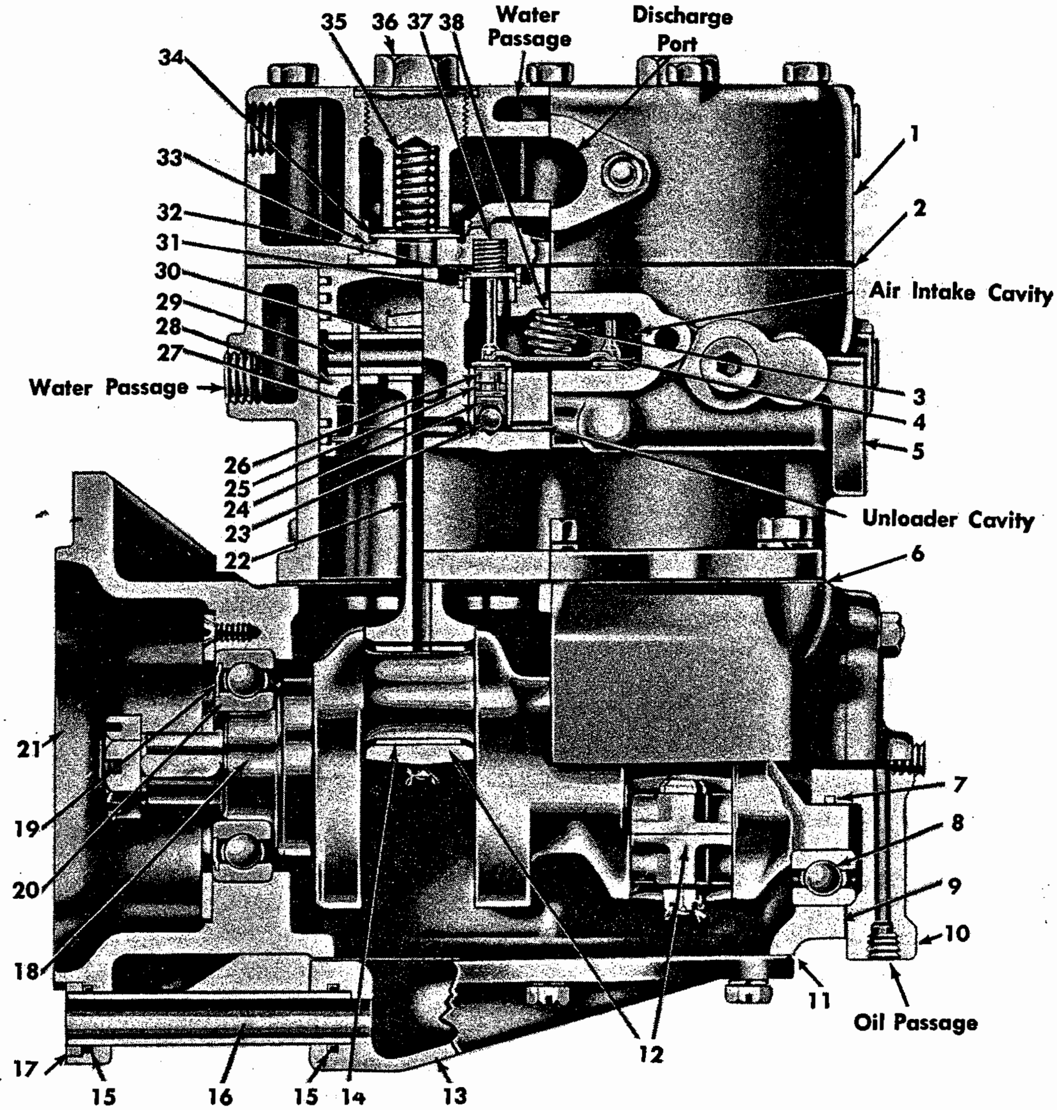
COMPRESSOR OPERATION

Air compressor crankshaft turns continuously while engine is running, but actual compression of air is controlled by the compressor governor. Acting in conjunction with compressor unloading mechanism, governor controls compression of air by loading or unloading compressor when pressure in air system reaches the desired maximum or minimum.

OPERATION WITH UNLOADER VALVE CLOSED (COMPRESSING) (Figs. 28 and 29)

During the downstroke, a partial vacuum is created above each piston. Intake air forces open the inlet valve and air fills cylinder.

As piston starts upstroke, the air pressure on top of inlet valve plus inlet valve return spring force closes the inlet valve. As air above piston is further compressed, pressure lifts discharge valve and compressed air is forced through discharge line into reservoir. At start of downstroke



1 Cylinder Head
2 Cylinder Head Gasket
3 Unloader Spring
4 Unloader Spring Saddle
5 Cylinder Block
6 Cylinder Block Gasket
7 Cover Oil Seal Ring
8 Crankshaft Rear Bearing
9 End Cover Gasket
10 Crankcase Rear End Cover
11 Crankcase Bottom Cover Gasket
12 Connecting Rod Bearing Cap
13 Crankcase Bottom Cover
14 Connecting Rod Bearing Insert
15 Oil Drain Tube Seal
16 Oil Drain Tube
17 Oil Drain Tube Gasket
18 Crankshaft
19 Crankshaft Front Bearing Retainer
20 Crankshaft Front Bearing
21 Crankcase
22 Connecting Rod
23 Unloader Cup Stop
24 Unloader Cup
25 Unloader Piston O-ring
26 Unloader Piston
27 Piston Pin Lock Wire
28 Piston
29 Piston Pin
30 Connecting Rod Bushing
31 Inlet Valve Guide
32 Inlet Valve
33 Discharge Valve Seat
34 Discharge Valve
35 Discharge Valve Spring
36 Discharge Valve Cap Nut
37 Inlet Valve Spring
38 Unloader Spring Seat

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Figure 27—Air Compressor Assembly

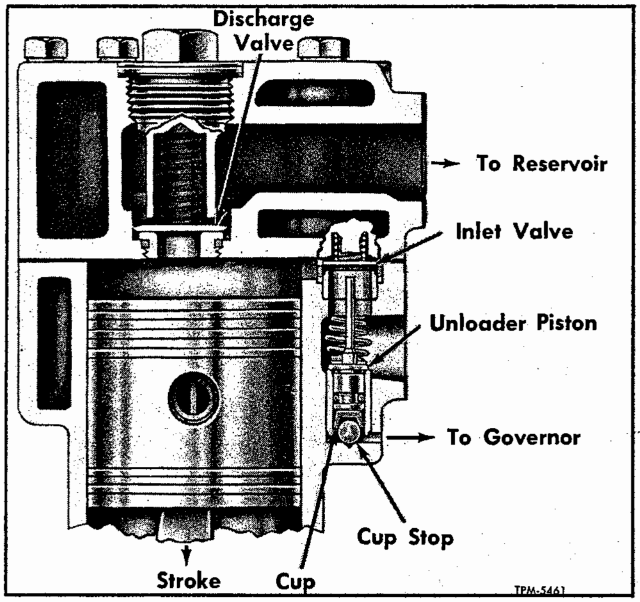


Figure 28—Intake of Air

discharge valve returns to seat, blocking return flow of compressed air to cylinder as cycle is repeated.

OPERATION WITH UNLOADER VALVES OPEN (NOT COMPRESSING) (Fig. 30)

When air pressure in system reaches maximum pressure for which governor is set, air pressure passes through governor into unloader cavity below unloader piston cups in compressor cylinder block. Upward movement of unloader pistons caused by air pressure lifts both air inlet valves off inlet valve seats. With both inlet valves unseated, the unloader cavity in the cylinder block forms a passage between the cylinders above the pistons. Upstroke of one piston exhausts air into cylinder of other piston on downstroke, without compression.

When pressure in air system is reduced to governor cut-in setting, the governor releases pressure from beneath unloader pistons. Pressure of unloader spring on unloader spring saddle, acting against reduced governor pressure, forces pistons away from inlet valves. As inlet valve springs in turn overcome reduced plunger pressure, inlet valves reseat and compression is resumed.

COMPRESSOR MAINTENANCE

It is important that inspection and adjustments listed below be made at intervals determined by severity of service.

1. Remove cylinder head and clean carbon away from discharge valves and inlet valves.
2. Check compressor discharge line. Make sure line is not choked with carbon.
3. Check compressor mounting bolts and tighten if necessary.
4. Make sure oil and air lines and connections are tight and free from leaks.
5. When draining engine cooling system to prevent freezing, be sure and remove drain plug from compressor cylinder block.

COMPRESSOR REPLACEMENT

REMOVAL (Fig. 26)

1. Drain engine cooling system.
2. Disconnect water, air, and oil lines from compressor.

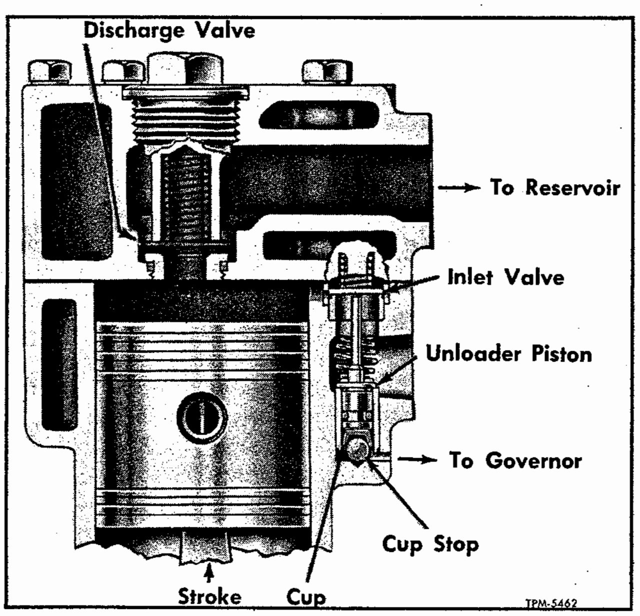


Figure 29—Compression of Air

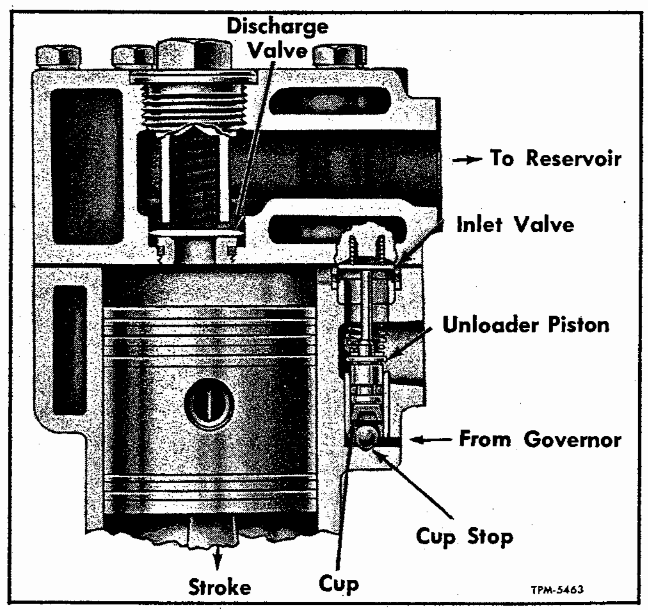


Figure 30—Unloading of Air

3. Remove nuts and lock washers from four studs attaching air compressor to gear train cover. Pull compressor straight back off studs and remove from vehicle.

INSTALLATION (Fig. 26)

1. Before installing compressor, examine hub on compressor crankshaft and drive disc on camshaft gear for worn or broken teeth. Check backlash between teeth in hub and teeth on drive coupling, also between teeth in drive disc and teeth on coupling. New limits are 0.000 to 0.001" backlash. If backlash is appreciably greater than this, drive disc or hub (or both) must be replaced.

2. Make sure mating surfaces of air compressor flange and gear train cover are clean. Place new compressor to gear train cover gasket on studs. Make sure gasket around oil return tube is in place and in good condition.

3. Insert damper spring in drive coupling and place spring end of drive coupling into hub on compressor crankshaft. Place compressor in position on gear train cover, guiding teeth on coupling into mesh with teeth in drive disc. Install nuts and lock washers on studs and tighten firmly.

4. Connect all water, air, and oil lines, making sure connections are tight.

5. Make sure drain plug is installed in compressor cylinder block, then fill cooling system.

COMPRESSOR DISASSEMBLY

NOTE: Key numbers in text refer to figure 27.

The crankcase, crankcase cover, cylinder block, cylinder head, and air inlet elbow are so designed that they may be assembled in different ways to meet installation requirements; therefore, these parts should be marked prior to disassembly so that they may be assembled in correct relationship to each other.

CYLINDER HEAD REMOVAL AND DISASSEMBLY

1. Remove all cylinder head cap screws, then lift off cylinder head assembly (1). Tap head lightly with soft hammer, if necessary, to break gasket joint.

2. Scrape cylinder head and block, if necessary, to remove any part of gasket (2) sticking to gasket surface.

3. Remove discharge valve cap nuts (36) and lift out discharge valve springs (35) and discharge valves (34). Remove discharge valve seats. Remove inlet valve springs (37) and inlet valves (32) from top of cylinder block.

PISTON AND CONNECTING ROD REMOVAL AND DISASSEMBLY

1. Before removing, mark each piston. Marks will be used to resemble parts in original position. Connecting rods and caps have center punch marks showing proper position of cap on rod.

2. Remove cotter pins and nuts from connecting rod bolts. Remove connecting rod bearing caps and bearing inserts. Do not remove bolts from rods. Push pistons with connecting rods attached out top of cylinder block. Replace caps on rods with inserts in place to prevent damage to bearing inserts.

3. Remove piston rings from pistons. If connecting rods are to be removed from pistons, remove piston pin lock wires (26), then press piston pins out of pistons and connecting rods.

CAMSHAFT REMOVAL

1. Remove cotter pin and nut from front end of crankshaft and pull drive hub off shaft. Remove drive hub key from keyway in shaft.

2. Remove cap screws attaching rear end cover (10) to crankcase and remove cover and gasket (9). Remove oil seal ring (7) from boss on cover.

3. Remove three screws attaching crankshaft front bearing retainer (19) to crankcase and remove retainer.

4. Place crankcase on arbor press bed, front (drive) end up, and place blocks under crankcase so pressure will not be placed on rear end cover studs. Pressing on threaded end of crankshaft, press crankshaft and rear bearing out of crankcase.

5. Using a suitable puller, pull rear bearing (8) off crankshaft. Using a bearing driver from inside of crankcase, drive front bearing (20) out of crankcase.

CYLINDER BLOCK REMOVAL

1. Remove screws and lock washers securing air compressor governir, and remove governor and governor gasket.

2. Remove cap screws securing cylinder block to crankcase and remove cylinder block and cylinder block gasket.

3. Insert screwdriver blade under unloader spring and raise spring off unloader spring saddle. Remove spring, spring seat, and spring saddle.

4. Lift unloader pistons out of bores. Apply air pressure through unloader passage to force out cups. Tilt crankcase to allow cup stops to roll out of bores. Discard cups and cup stops. Remove and discard unloader piston O-rings.

CLEANING AND INSPECTION OF COMPRESSOR PARTS

CLEANING

1. General. Thoroughly wash all parts in a suitable cleaning fluid to remove all traces of dirt, oil, or grease.

2. Cylinder Head. Soak cylinder head in clean-

ing fluid to loosen carbon from discharge valve cavities and unloading cavity, and to loosen rust and scale. Blow dirt out of all cavities with compressed air. Scrape carbon and dirt from all surfaces. Scrape gasket particles from gasket surfaces.

3. Discharge Valves. Clean discharge valves not worn excessively or damaged, by lapping with crocus cloth held on a flat surface.

4. Oil Passages. Thoroughly clean oil passages through crankshaft, connecting rods, and crankcase rear end cover. If necessary, prod oil passages with a piece of wire; then flush passages with cleaning fluid and blow out with compressed air.

5. Cylinder Block. Soak cylinder block in cleaning fluid to loosen carbon and dirt from air intake cavity. Clean rust and scale from water passages. Blow out all passages with compressed air.

6. Pistons. Scrape all carbon and dirt out of ring grooves in pistons. Clean drain holes in oil ring grooves.

7. Ball Bearings. Immerse bearings in cleaning fluid, then brush off old lubricant. Blow bearings dry with compressed air, and wrap in clean cloth. Avoid spinning bearings with air blast, as spinning might damage bearings.

8. Crankcase Bottom Cover. Wash crankcase bottom cover in cleaning fluid. Remove all sediment from sump in bottom of cover.

INSPECTION

1. Cylinder Head. Inspect cylinder head for cracks or breaks. Replace with new head if cracked or damaged.

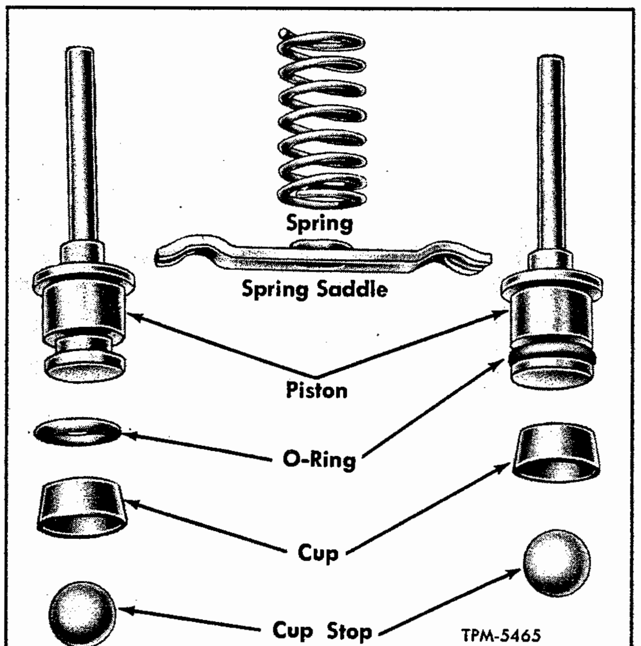


Figure 31—Unloader Assembly Components

2. Inlet and Discharge Valve Springs. Discard used inlet and discharge valve springs and replace with new springs.

3. Inlet and Discharge Valves and Seats. Inspect inlet and discharge valves and seats for signs of excessive wear. Replace valves if grooved deeper than 0.003" at point of seat contact. Replace valve seats if condition is such that seats can no longer be refaced.

4. Unloading Pistons (Fig. 31). Inspect pistons for signs of damage or excessive wear. With new O-rings, unloading pistons should slide easily in bores. Check bores for scratches or damage that might increase O-ring wear. Check unloading piston return spring dimension and compare with "Specifications" listed at end of this section. Replace spring if necessary.

5. Crankcase and End Cover. Check crankcase and end cover for cracks or other damage. Replace with new parts if damaged. Check fit of oil seal ring in groove of rear end cover. Ring must be snug fit in groove, and must have 0.008" to 0.015" clearance at gap when placed in end of crankshaft.

6. Crankcase Bearing Bores. Check fit of ball bearings in crankcase bearing bores. Bearings should require a finger press fit. Replace crankcase if bores are worn or damaged.

7. Cylinder Block (Fig. 32). Use telescoping gauge to check bores for out-of-round and taper. Bores which are scored or out-of-round more than 0.002" or tapered more than 0.003" must be rebored, honed, or ground oversize. Pistons and rings 0.010", 0.020", and 0.030" oversize are available. Cylinder bores must be smooth, straight and round and must be finished with a 500 (or finer) grit hone. The clearance between piston and cylinder wall must not be less than 0.002" or more than 0.004". Replace cylinder block if cracked or damaged.

Figure 32—Measuring Cylinder Bore Diameter

8. Pistons (Fig. 33). Examine pistons for scoring, cracks, or damage of any kind. Measure outside diameter of piston with a micrometer and compare this measurement with the inside diameter of cylinder bore. Clearance should not be less than 0.002" or more than 0.004". Piston over 0.004" smaller than cylinder bore must be replaced with an oversize piston.

9. Piston Pins and Bushings. Check fit of piston pins in pistons and connecting rods. Pins must be from 0.0000" to 0.0002" loose in pistons. If piston pin is too loose in piston, the pin, piston, or both must be replaced. Check fit of piston pins in connecting rod bushings by rocking pins in bushings. If looseness is evident, replace connecting rod bushings as directed under "Compressor Repair." Discard all piston pin lock wires.

10. Piston Rings (Fig. 34). Check fit of piston rings in ring grooves, and check ring gap with ring in cylinder bore. Clearance between rings and sides of ring grooves should be from 0.0035" to 0.0055" for two wide rings and from 0.002" to 0.004" for three narrow rings as shown in figure 35. Ring gap should be from 0.005" to 0.015".

11. Connecting Rods and Bearings. Check fit of connecting rod bearing inserts on crankshaft journals. Clearance between bearings and crankshaft journals must not be less than 0.002" or more than 0.004". Replace bearing inserts if clearance is excessive or if bearings are cracked or flaked. Connecting rod caps are not interchangeable. Position caps so that locking slots are both located adjacent to same cap screw.

12. Crankshaft. Crankshaft journals should not be out-of-round more than 0.001", ridged, or scored. If grinding is necessary, do not grind fillets at ends of journals. Connecting rod bearing inserts are available in 0.010", 0.020", 0.030" undersize for reground crankshafts. Check main bearing journals for excessive wear. Dimensions should be such that ball bearings are a press fit on journals.

13. Crankshaft Bearings. Examine bearings for wear or flat spots. Replace, if necessary, with new bearings.

COMPRESSOR REPAIR

DISCHARGE VALVES AND SEATS

1. Remove slight scratches and pits from discharge valve seats. Use lapping stone, grinding compound, lapping disc, and valve grinding tool.

2. Place discharge valves on valve seats, install discharge valve springs in cap nuts, and thread cap nuts firmly into cylinder head. To test discharge valves for leakage, connect air line to discharge port in cylinder head. Apply 100 pounds air pressure to valves and apply soap suds to discharge valve openings in bottom of cylinder head. Leakage in excess of a one-inch bubble in one second is not permissible. If leakage is excessive, leave air pressure applied. Using a fiber or hardwood dowel and a light hammer, tap valves off seats several times. This should improve fit of valve on seat. Check leakage around top of discharge valve cap nuts by applying soap suds to this area. Leakage must not exceed a one-inch bubble in five seconds. Shut off air pressure and disconnect line from cylinder head.

3. Remove discharge valve seats too badly worn for refacing. Thread new seats into head and tighten firmly. With new valves, discharge valve travel should be from 0.056" to 0.070".

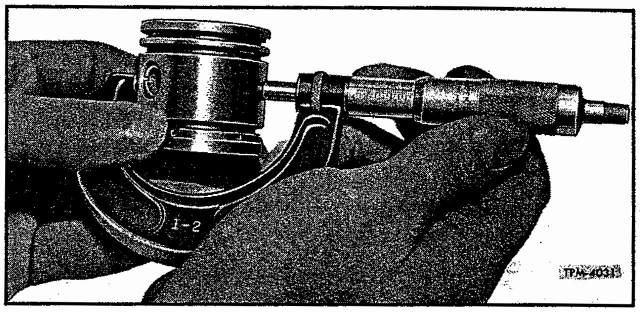


Figure 33—Measuring Piston Diameter

INLET VALVES AND SEATS

1. Remove slight scratches or pits from inlet valve seats. Use lapping stone, grinding compound, lapping disc, and valve grinding tool. For dimensions, refer to "Specifications" at end of this section.

2. Inlet valves not badly worn or damaged can be repaired by lapping valves on a piece of crocus cloth held on a flat surface.

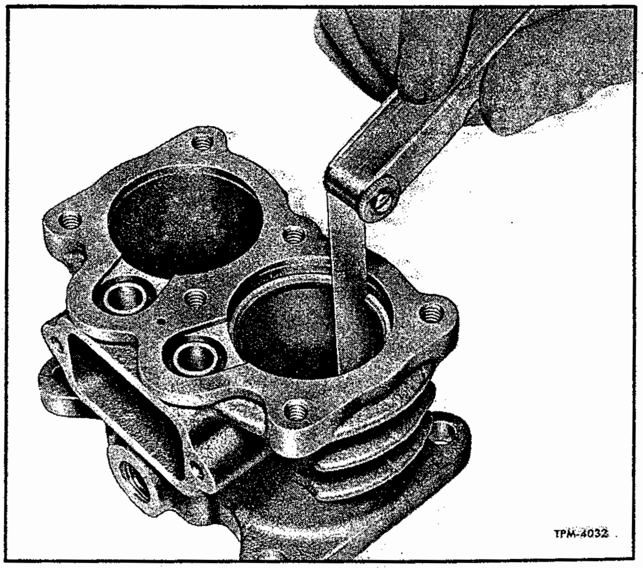


Figure 34—Measuring Piston Ring Gap

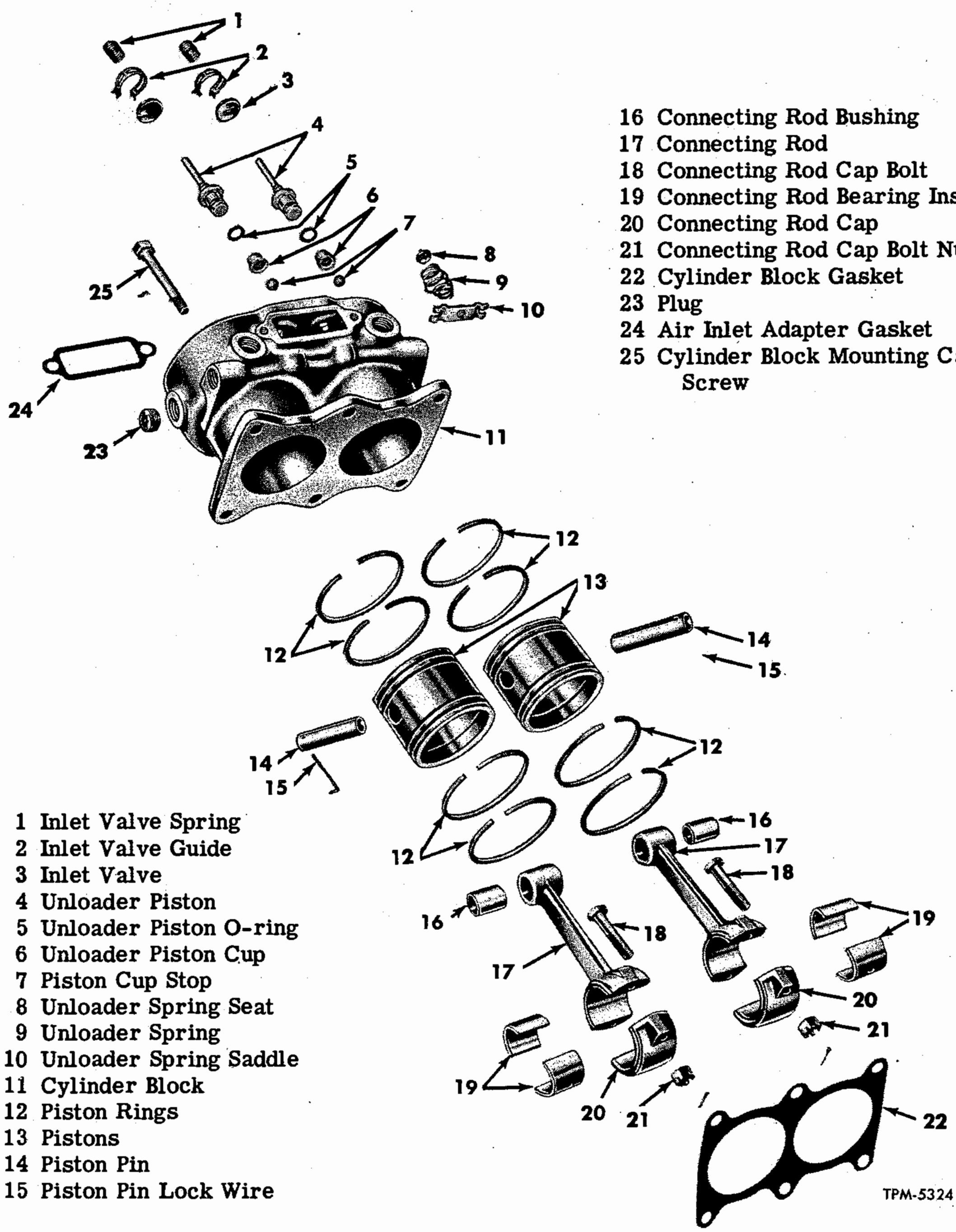
AIR COMPRESSOR AND GOVERNOR

UNLOADER PISTONS

1. Replace O-rings on unloader pistons. Install pistons in bores carefully so as not to damage O-rings. Pistons should slide easily in bores.
2. Test unloader piston operation after assembly, by applying 100 pounds air pressure to unloader cavity. Check unloader piston leakage by coating piston with soap suds. Leakage should not exceed a 1/2" soap bubble in five seconds.

CONNECTING ROD BUSHINGS

If piston pin bushings in connecting rods require replacement as previously indicated in step 9 under "Inspection," press old bushings out of connecting rods. Press new bushings in, making sure the oil holes in the bushings line up with the oil passages in the connecting rods. Bushings must then be reamed, honed, or bored to provide 0.0003"-0.0015" clearance on piston pin.



16 Connecting Rod Bushing
17 Connecting Rod
18 Connecting Rod Cap Bolt
19 Connecting Rod Bearing Insert
20 Connecting Rod Cap
21 Connecting Rod Cap Bolt Nut
22 Cylinder Block Gasket
23 Plug
24 Air Inlet Adapter Gasket
25 Cylinder Block Mounting Cap Screw

1 Inlet Valve Spring
2 Inlet Valve Guide
3 Inlet Valve
4 Unloader Piston
5 Unloader Piston O-ring
6 Unloader Piston Cup
7 Piston Cup Stop
8 Unloader Spring Seat
9 Unloader Spring
10 Unloader Spring Saddle
11 Cylinder Block
12 Piston Rings
13 Pistons
14 Piston Pin
15 Piston Pin Lock Wire

Figure 35—Cylinder Block Components

COMPRESSOR ASSEMBLY

CRANKSHAFT INSTALLATION

NOTE: Key numbers in text refer to figure 27.

1. Press crankshaft rear bearing (8) onto rear end of crankshaft (18), using a bearing driver to exert force on bearing inner race.

2. Insert forward end of crankshaft through bearing bore in rear end of crankcase and press bearing and crankshaft into crankcase (21), using arbor press and bearing driver. Driver must be large enough to exert force on bearing outer race. Press in until the inner edge of the bearing is flush with the inner edge of the bearing bore.

3. Turn crankcase over and place a support under rear end of crankshaft and rear bearing. Place crankshaft front bearing (20) over end of crankshaft. (If a shielded bearing is used, the shielded side must be up.) Using a suitable bearing driver over end of crankshaft, press bearing onto crankshaft and into crankcase until it bottoms against shoulder in crankcase. Bearing driver must be of a size to exert force on both the inner and outer bearing races. Install crankshaft front bearing retainer (19) and attach with three screws. Tighten screws firmly; then stake in place.

4. Install cover oil seal ring (7) in seal ring groove in boss on forward side of crankshaft rear end cover (10). Position new end cover gasket (9) at rear end of crankcase. Install rear end cover, making sure that the seal ring enters the bore in the rear end of crankshaft. Install cap screws and lock washers and tighten firmly.

5. Install key in keyway in front end of crankshaft, install drive hub on shaft, and secure with nut and cotter pin.

CYLINDER BLOCK INSTALLATION (Fig. 35)

Place new cylinder block gasket on crankcase. Position cylinder block on crankcase, aligning marks made before disassembly. Install cap screws and lock washers. Tighten firmly.

PISTON AND CONNECTING ROD ASSEMBLY AND INSTALLATION (Fig. 35)

1. Position connecting rod in piston and press piston pin into piston with lock wire holes in pin aligned with lock wire holes in piston.

2. Install new piston pin lock wires in piston pin so that long end extends through piston and pin. Snap short end into lock wire hole at bottom of piston skirt.

3. Install piston rings in grooves of pistons. Rings must be installed in proper location and with pip marks upward. Refer to figure 36 for proper clearance dimensions and location of rings. Stagger position of ring gaps.

4. Press bearing inserts into rod and cap by hand, with locking slots in proper alignment (all slots on side of same cap bolt).

5. Lubricate pistons, rings, piston pin bushings, and bearing inserts with clean engine oil.

6. Turn crankshaft to position bearing journal nearest pulley end of crankshaft (No. 1) downward. Remove bearing cap from No. 1 connecting rod leaving connecting rod bolts in rod.

7. Insert No. 1 connecting rod and piston through top of No. 1 cylinder, as previously marked, and seat squarely on connecting rod bearing journal. Install bearing cap. For proper assembly, two slots in bearing inserts and in rod and cap should be on side of same cap bolt. Install nuts and tighten firmly, then install two new cotter pins.

8. Install No. 2 piston and connecting rod in same manner as described above.

UNLOADER PISTON

1. Apply liberal coating of engine oil on each piston, O-ring, piston bore, cup, and cup stop. Drop cup stop (23) into piston bore. Place cup (24) squarely on top of bore (concave side of cup should be down). Carefully work cup into bore. Insert piston (26) in bore and push cup downward against cup step. Piston should slide easily in bore.

2. Install unloader spring seat (38) and unloader spring saddle (4). Install unloader spring.

CYLINDER HEAD ASSEMBLY AND INSTALLATION (Fig. 37)

1. Install discharge valve seats (33). Place discharge valve (34) on seat through opening in top of cylinder head. Place discharge valve spring (35) in discharge valve cap nut (36). Thread cap nut into cylinder head. Tighten nuts firmly.

2. Place inlet valves (32), inlet valve guides (31), and inlet valve springs (37) in top of cylinder block.

3. Install new cylinder head gasket on cylinder block. Carefully align inlet valve springs with inlet valve guides in cylinder head. Align marks made

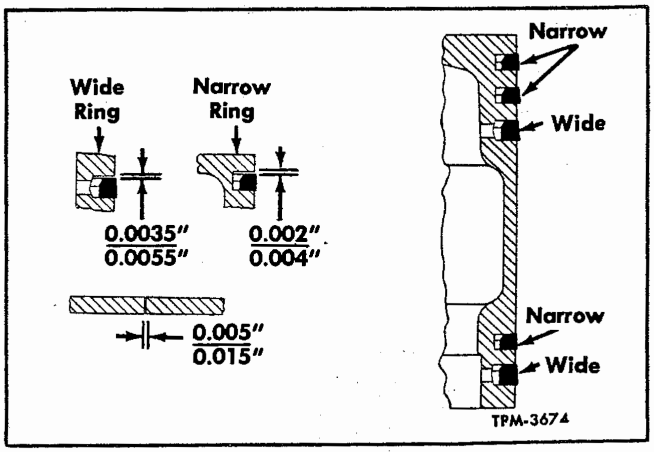


Figure 36—Piston Ring Arrangement and Clearance

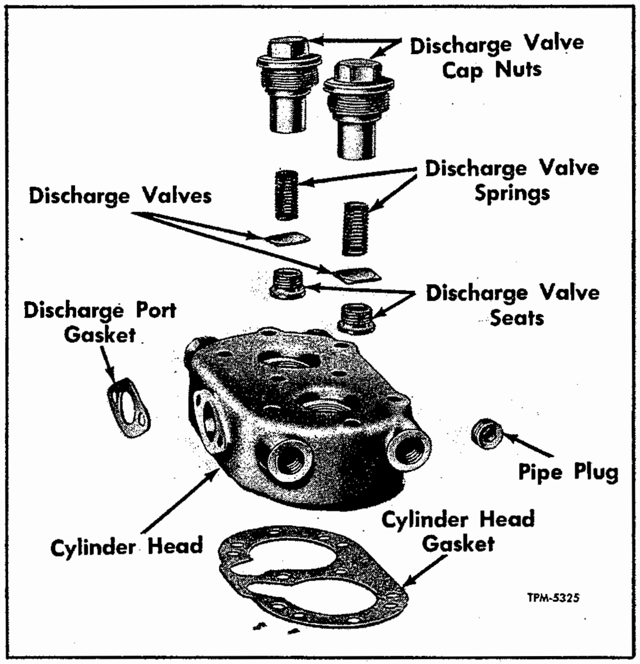


Figure 37—Cylinder Head Components

before disassembly and install cylinder head on cylinder block. Install cylinder head cap screws and tighten evenly and firmly. Replace pipe plugs.

4. Install new gasket and replace air inlet elbow.

COMPRESSOR TESTS AFTER OVERHAUL

After overhauling air compressor, the following tests are recommended to determine if compressor is operating properly. Connect an oil supply line, having at least 15 pounds pressure, to compressor rear end cover opening. Plug other opening in end cover and in crankcase. Provisions must be made for drainage of oil from crankcase during test. Water must be circulated through compressor water passages while compressor is operating. Figure 38 shows a testing hook-up which can be used to make the following tests.

RUN-IN TEST

Run compressor for one-half hour at 1750 rpm with compressor discharge port open to atmosphere. Check for oil leaks, overheated bearings and excess noise.

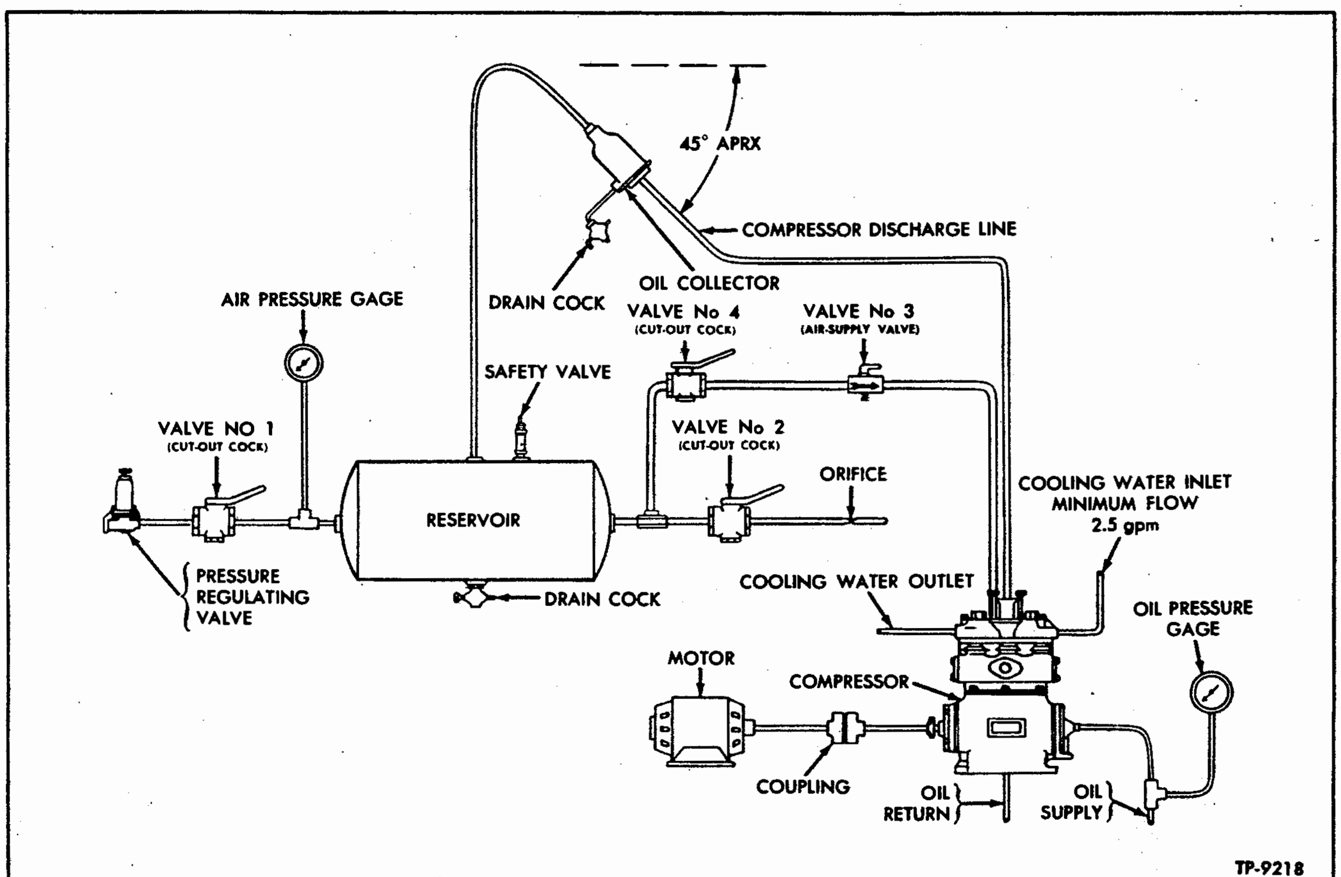


Figure 38—Typical Air Compressor Test Hook-Up

OIL PASSING TEST

Run compressor for one-half hour at 1750 rpm pumping against 50 pounds air pressure with an oil trap connected in the discharge line (fig. 38). Close valves 2 and 4, open valve 1, and adjust pressure regulating valve to maintain 50 pounds air pressure in the reservoir. Cover air inlet opening in compressor intake cavity with a plate drilled at center to a 3/8" orifice. Drain the oil collector completely before starting test. At end of half hour test, stop motor and open reservoir drain cock to drain air pressure completely. Open oil collector drain cock to collect and measure oil passed. The oil passed during this test must not exceed 2 cubic centimeters.

EFFICIENCY TEST

This test is made by running compressor one-half hour at 1750 rpm connected to a reservoir fitted with an orifice type exhaust fitting. Close valves 1 and 4 (fig. 38), open valve 2, and mount orifice in line beyond valve 2. Orifice should be 0.089" (No. 43 drill). With air exhausting continuously through orifice, compressor should maintain 75 pounds pressure in reservoir.

This test can also be used on a compressor before it is overhauled to determine the necessity of an overhaul. A compressor which does not maintain 60 pounds pressure in reservoir at 1750 rpm should be overhauled.

COMPRESSOR UNLOADER MECHANISM TEST

The compressor unloader mechanism can be tested by closing valves 1 and 2 and opening valves 3 and 4 (fig. 38). Run compressor until unloader mechanism operates; watch air pressure. Unloader mechanism should operate at 100 to 105 pounds, stopping further compression.

AIR COMPRESSOR GOVERNOR

Air compressor governor, acting in conjunction with the compressor unloading mechanism, automatically limits system pressure to a predetermined range by opening unloading valves and stopping compression when system pressure has been built up to maximum pressure limit (100-105 psi), and by closing unloading valves and starting compression when system pressure has dropped to minimum pressure limit (80-85 psi).

The governor consists essentially of a diaphragm upon which air pressure acts, a spring to control the movement of the diaphragm assembly, and a valve mechanism controlled by the position of the diaphragm assembly which admits air to or exhausts air from the unloading mechanism in compressor cylinder heads.

GOVERNOR OPERATION (Fig. 39)

Air pressure from the front air tank enters the governor at the port marked "RES," passes through the strainer, and is always present above the inlet valve and on one side of the diaphragm. As air pressure increases, the diaphragm and stem assembly move up against the resistance of the pressure setting spring. When the system pressure has reached the cut-out point (100-105 psi), the diaphragm has moved enough to seat the exhaust valve and open the inlet valve. When inlet valve is opened, system air pressure flows past the inlet valve and out the port marked "UNL" to the unloading mechanism, opening the unloading valves and stopping compression. With inlet valve open, air pressure also flows through the passages

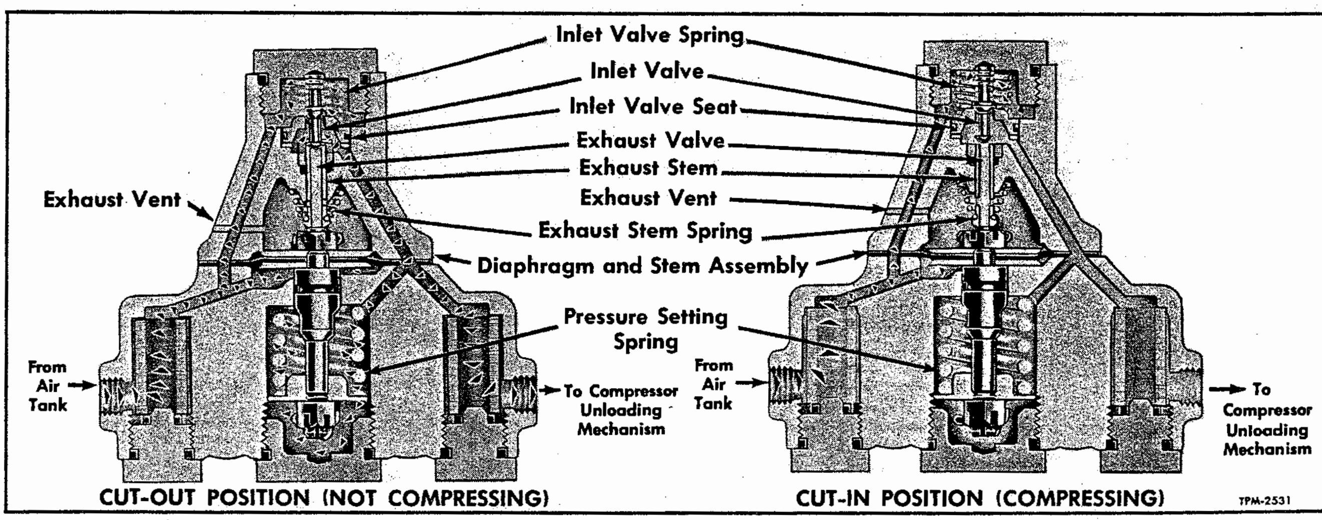


Figure 39—Air Compressor Type "D" Governor Operation

in the body to the cavity containing the pressure setting spring and, acting on the area of the stem, increases the effective force of the diaphragm further compressing the pressure setting spring and fully opening the inlet valve.

As pressure in system drops to the governor cut-in point (80-85 psi), the pressure acting on the diaphragm is reduced and the pressure setting spring moves the diaphragm and stem assembly downward, permitting the inlet valve to close and the exhaust valve to open. Opening the exhaust valve permits air pressure in the compressor unloading mechanism to escape through the hollow exhaust stem and the exhaust vent in the valve body. This allows the unloading valves in compressor cylinder head to close and compression of air is resumed. The opening of the exhaust valve also allows air to escape from the pressure setting spring cavity, thereby decreasing the effective force on the diaphragm and stem assembly so that a rapid and complete opening of the exhaust valve is obtained.

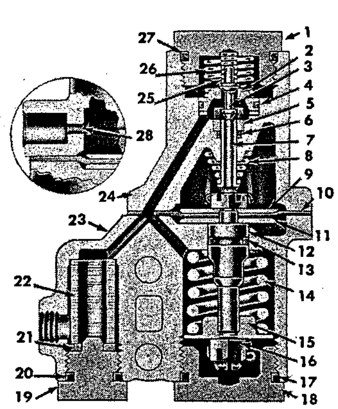
GOVERNOR TESTS (Fig. 40)

Operating Test

With engine running, build up air pressure in system and observe reading on air pressure gauge in gauge panel when governor cuts out, stopping further compression. Gauge reading when governor cuts out should be between 100 and 105 psi.

With engine still running, slowly reduce air pressure in system by applying and releasing brakes, and observe pressure registered by gauge when governor cuts in and compression is resumed. Gauge reading when governor cuts in should be between 80 and 85 psi.

Before condemning or adjusting the governor, be sure the dash gauge is registering accurately. This may be done by using an accurate test gauge to check the pressure registered by the dash gauge.



1 Valve Body Screw Cap
2 Inlet Valve Seat
3 Inlet-Exhaust Valve
4 Inlet Valve Seat Grommet
5 Guide Bushing
6 Exhaust Stem Grommet
7 Exhaust Stem
8 Exhaust Stem Spring
9 Diaphragm Upper Follower
10 Diaphragm
11 Diaphragm Lower Follower
12 Diaphragm Stem
13 Diaphragm Stem Grommet
14 Pressure Setting Spring
15 Spring Seat
16 Adjusting Nut
17 Grommet
18 Spring Cage Screw Cap
19 Strainer Screw Cap
20 Grommet
21 Felt Washer
22 Strainer
23 Spring Cage
24 Valve Body
25 Inlet Valve Spring
26 Seat Retaining Spring
27 Grommet
28 Exhaust Vent

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Figure 40—Air Compressor Type "D" Governor

Leakage Test

With governor in "cut-out" position, test for leakage at exhaust valve by applying soap suds to exhaust vent in valve body.

With governor in "cut-in" position, test for leakage at the inlet valve by applying soap suds to exhaust vent in valve body.

Leakage in excess of a 1-inch soap bubble in three seconds is not permissible in either of the above tests.

Coat the entire governor with soap suds to detect diaphragm, gasket, and cap screw leakage. No leakage is permissible.

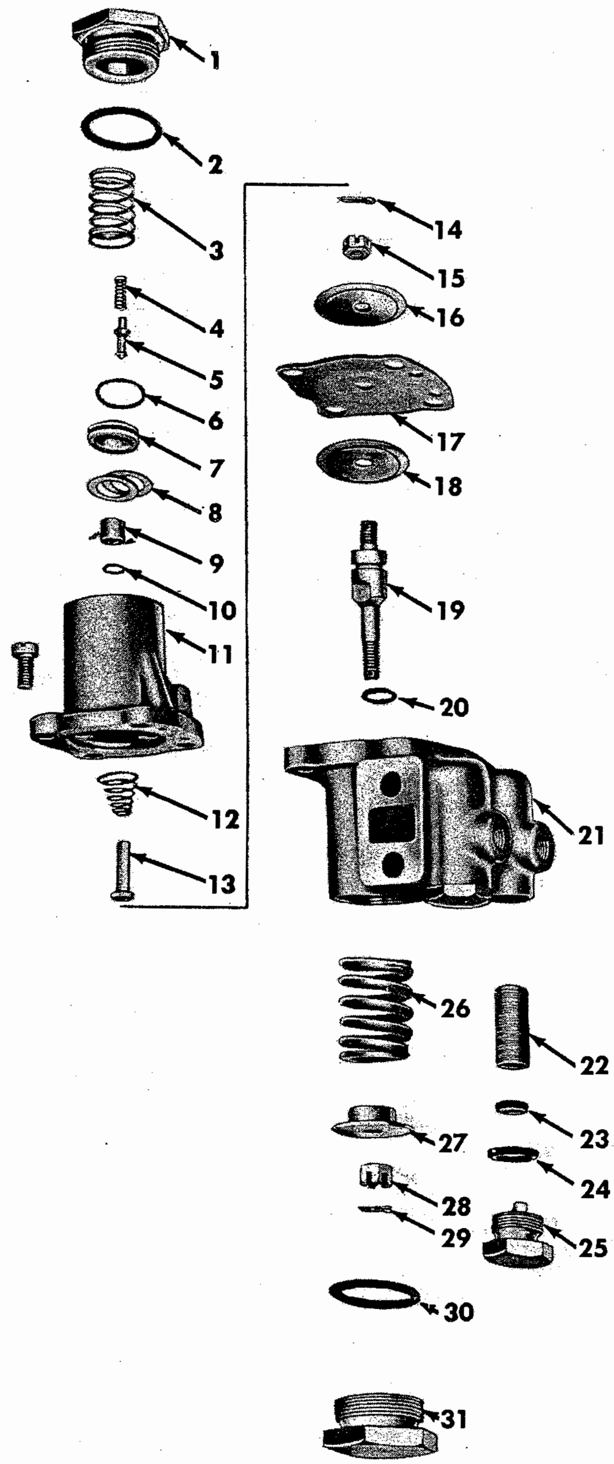
GOVERNOR ADJUSTMENT

If necessary to adjust governor settings, remove spring cage screw cap, the remove cotter pin from diaphragm stem and adjusting nut. Pressure settings are raised by turning adjusting nut clockwise, and lowered by turning adjusting nut counterclockwise. Cotter pin must be replaced after adjustment. The range between the cut-out and cut-in setting is fixed at approximately 20 psi and cannot be adjusted.

GOVERNOR DISASSEMBLY

Key numbers in text refer to figure 41.

1. Remove dirt and grease from outside of unit, using a brush and cleaning solvent.
2. Remove valve body screw cap (1), then remove inlet valve spring (4), seat retaining spring (3), and inlet-exhaust valve (5). Remove grommet (2) from screw cap.
3. Remove inlet valve seat (7), being careful not to damage inlet valve seating surface. Remove shims (8) from inlet valve seat bore in body. Remove grommet (6) from valve seat.
4. Remove spring cage screw cap (31). Remove grommet (30) from cap. Remove cotter pin (29) and adjusting nut (28) from diaphragm stem (19). Remove spring seat (27) and pressure setting spring (26).
5. Remove four cap screws attaching valve body (11) to spring cage (21). Separate valve body from spring cage. Remove exhaust stem (13) and spring (12) from body.
6. Remove diaphragm and stem assembly from spring cage. Remove cotter pin (14) and nut (15) from top of diaphragm stem, then remove diaphragm (17) and diaphragm followers (16 and 18) from diaphragm stem. Remove grommet (20) from diaphragm stem.
7. Using a hooked tool, remove grommet (10) from groove between guide bushing (9) and bore in valve body.



1 Valve Body Screw Cap
2 Grommet
3 Seat Retaining Spring
4 Inlet Valve Spring
5 Inlet-Exhaust Valve
6 Inlet Valve Seat Grommet
7 Inlet Valve Seat
8 Shims
9 Guide Bushing
10 Exhaust Stem Grommet
11 Valve Body
12 Exhaust Stem Spring
13 Exhaust Stem
14 Cotter Pin
15 Nut
16 Diaphragm Upper Follower
17 Diaphragm
18 Diaphragm Lower Follower
19 Diaphragm Stem
20 Diaphragm Stem Grommet
21 Spring Cage
22 Strainer
23 Felt Washer
24 Grommet
25 Strainer Screw Cap
26 Pressure Setting Spring
27 Spring Seat
28 Adjusting Nut
29 Cotter Pin
30 Grommet
31 Spring Cage Screw Cap

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Figure 41—Type "D" Governor Components

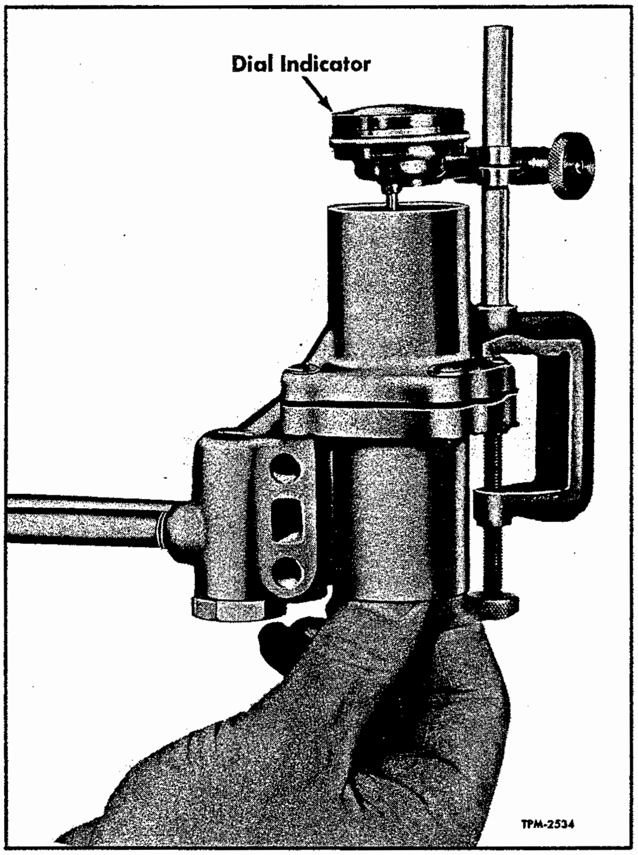


Figure 42—Checking Governor Valve Travel

8. Remove two strainer screw caps (25), grommets (24), felt washer (23), and strainers (22) from spring cage.

CLEANING AND INSPECTION

Key numbers in text refer to figure 41.

1. Clean all parts in cleaning solvent, making sure all air passages through valve body, spring cage, and exhaust stem are not obstructed in any way. Make sure air strainers (22) are thoroughly cleaned.

2. Inspect both seats on the inlet-exhaust valve (5) for grooves or damage. If either seat is grooved or damaged, replace inlet-exhaust valve.

3. Inspect inlet valve seat (7) for wear or damage. Replace seat if worn or damaged.

4. Inspect seat in upper end of exhaust stem (13). Replace stem if seat is worn or damaged. Also check fit of exhaust stem in valve body (11). Stem should be a neat sliding fit in body. Replace stem if excessively loose.

GOVERNOR ASSEMBLY

Key numbers in text refer to figure 41. Refer to figure 17 for assembly view.

1. Install new greased grommet (10) in groove between guide bushing (9) and bore in valve body (11). Install exhaust stem spring (12) and exhaust stem (13) in body, being sure stem is a neat sliding fit in body.

2. Assemble diaphragm lower follower (18), diaphragm (17), and upper follower (16) on diaphragm stem (19), making sure beveled side of both followers are toward diaphragm. Install nut (15), tighten to 10-15 inch-pounds torque, and secure with cotter pin (14). Bend both legs of cotter pin toward the diaphragm.

3. Install new greased grommet (20) in groove in diaphragm stem (19). Install diaphragm and stem in spring cage (21), making sure stem is a neat sliding fit in bore in spring cage.

4. Assemble valve body on diaphragm and spring cage, making sure all air passages are aligned, and secure with four cap screws.

5. Install strainers (22), felt washers (23), and strainer screw caps (25), in bottom of spring cage, using new greased grommets (24) in grooves in screw caps. Tighten screw caps firmly.

6. Measure total valve travel (fig. 42) by pulling diaphragm stem down as far as possible and setting dial indicator at zero when contacting top of exhaust stem. Push diaphragm stem completely in and read total valve travel on dial indicator. Total travel should be 0.060" to 0.098".

7. Install new greased grommet (6) in groove on inlet valve seat (7), then install inlet valve seat and inlet-exhaust valve, then repeat the above check starting with the indicator zeroed on end of inlet-exhaust valve. Add or remove shims (8) under inlet valve seat until valve travel is within 0.030" to 0.040".

8. Install inlet valve seat retaining spring (3) and inlet valve spring (4). Install new greased grommet (2) on valve body screw cap (1) and thread screw cap into valve body. Tighten screw cap firmly.

9. Install pressure setting spring (26) and spring seat (27) on diaphragm stem in spring cage and secure with adjusting nut (28).

10. Mount governor on suitable test rack or on vehicle and connect air pressure source to port marked "RES." Leave spring cage screw cap (31) removed.

11. Build up pressure from zero and note pressure at which air starts to escape from spring cage. If less than 100 psi, turn adjusting nut clockwise; if above 105 psi, turn adjusting nut counterclockwise. After final adjustment, leakage should start at 100-105 psi. Secure adjusting nut (28) with cotter pin (29).

12. Install new greased grommet (30) in groove in spring cage screw cap (31) and thread cap into spring cage. Tighten firmly.

Hand Brake

Hand brake is two-shoe, external contracting type, mounted at output shaft on transmission. Brake shoes act on outside of brake drum, which is bolted to transmission output shaft companion flange. Brake shoes are actuated through rods and levers by hand brake lever, located at left of driver.

One-piece block type lining is bolted to each shoe. Bolt holes in lining are counterbored to permit maximum amount of wear on linings before bolt heads are in danger of scoring brake drum.

Lower ends of shoes are mounted on an eccentric anchor pin which provides means of equalizing lining to drum clearance at lower ends of both shoes. Anchor pin is held in position in anchor bracket by two clamp bolts. Anchor pin is drilled and threaded for lubrication fitting. Anchor pin ends of brake shoes are equipped with replaceable bushings.

Upper ends of brake shoes are held in place by an adjusting screw inserted through both shoes and locating bracket. Adjusting nuts and springs on adjusting screw provide independent adjustment for upper end of each shoe. Lever pin holes in brake shoe are equipped with replaceable bushings.

HAND BRAKE ADJUSTMENT

INITIAL ADJUSTMENT (Fig. 43)

Adjustment is necessary when brake shoes have been relined or replaced, or when anchor pin has been moved from its original setting.

1. Place hand brake lever in fully released position.
2. Remove cotter pins; then loosen nuts on clamp bolts in anchor bracket.
3. Turn anchor pin as necessary to equalize clearance between brake drum and lower end of lining on each shoe. Tighten clamp bolts in anchor bracket and secure with new cotter pins.
4. Adjust upper end of lining to drum clearance as directed under "Adjustment for Wear" following:

ADJUSTMENT FOR WEAR (Fig. 43)

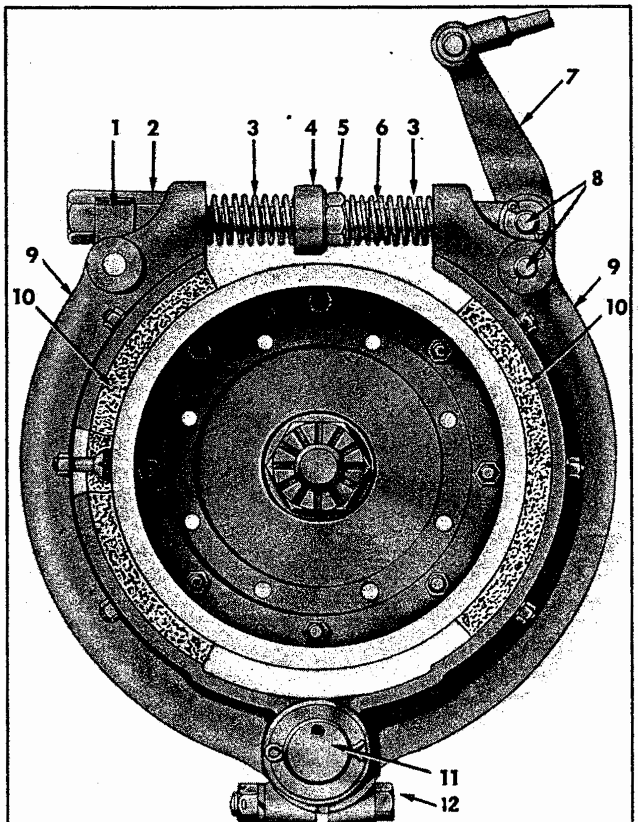
Adjustment is to compensate for normal wear. Need of adjustment is indicated when hand brake lever reserve travel is less than one-half the ratchet range.

Before making adjustment, check for equal clearance between brake drum and lower end of lining on each shoe. If clearance is not equal for both shoes, make "Initial Adjustment" previously described.

1. Place hand brake lever in fully released position.
2. Loosen inner adjusting nut check nut.
3. Turn inner and outer adjusting nuts as necessary to obtain 0.030" to 0.040" clearance between upper end of each lining and brake drum.
4. Tighten inner adjusting nut check nut and make sure outer adjusting nut is held in position by lock spring when adjustment is completed.

BRAKE SHOE REMOVAL

1. Disconnect brake rod from brake shoe lever.
2. Remove cotter pins from brake shoe lever pins; then remove pins from lever and brake shoe. Remove lever.
3. Remove outer adjusting nut, swing brake shoe out and off adjusting screw; then remove outer spring from screw. Remove nuts and lock washers



1 Adjusting Nut Spring	8 Lever Pins
2 Outer Adjusting Nut	9 Brake Shoe
3 Springs	10 Brake Shoe Lining
4 Locating Bracket	11 Anchor Pin
5 Inner Adjusting Nut	12 Anchor Bracket Clamp Bolt
6 Check Nut	
7 Lever	

Figure 43—Hand Brake Shoes Installed

from three brake locating bracket studs and remove locating bracket. Remove inner adjusting nut, check nut, and inner spring from adjusting screw; then remove adjusting screw from brake shoe.

4. Remove nuts from studs attaching anchor pin bracket to bottom of transmission case; lower brake shoes, anchor pin, and anchor bracket as an assembly from transmission and brake drum. Remove cotter pin and washer from end of anchor pin and slide brake shoes off pin.

5. If necessary to remove brake drum, transmission must be removed. Refer to TRANSMISSION (SEC. 17) for procedure.

INSPECTION

1. Inspect brake lining and replace if worn down close to bolt heads. Make sure new lining fits firmly against shoe.

2. Examine anchor pin bushings in lower ends of brake shoes and brake shoe pin bushings in upper end of brake shoes for wear. Replace bushings if worn excessively. Burnish bushings after installation to dimensions listed in "Specifications" at end of this section.

3. Check anchor pin for wear and replace if necessary. Make sure lubricant passages in anchor pin are not clogged.

BRAKE SHOE INSTALLATION

1. Install brake shoe anchor pin in anchor pin bracket; then position lower ends of brake shoes on anchor pin. Attach brake shoes on anchor pin with washer and cotter pin.

2. Raise assembly into position, guiding brake shoes up around brake drum. Attach anchor pin bracket to transmission with three stud nuts and lock washers.

3. Insert brake shoe adjusting screw through upper end of inner brake shoe. Place inner spring, check nut, inner adjusting nut, and brake locating bracket on adjusting screw.

4. Attach locating bracket to transmission with three stud nuts and lock washers.

5. Install brake shoe lever, attaching lever to adjusting screw and brake shoe with lever pins and cotter pins.

6. Place outer spring on adjusting screw, then swing outer shoe into position over adjusting screw and install outer adjusting nut.

7. Connect brake rod to brake shoe lever.

8. Lubricate anchor pin as directed in LUBRICATION (SEC. 13). Lubricate brake shoe pins with oil can. Adjust brake shoes as previously directed under "Hand Brake Adjustment" in this section.

HAND BRAKE LINKAGE

Hand brake lever, located at left of driver, is attached to outer end of hand brake cross shaft. Cross shaft is supported at each end by permanently lubricated, self-aligning, bushing-type bearings. Inner end of cross shaft carries a lever to which front end of brake rod is connected. Rear end of brake rod incorporates a spring type damper and is connected to a bell-crank mounted on a bracket attached to engine compartment bulkhead. Bellcrank is connected to brake lever by an adjustable pull rod. Lubrication fittings are provided for brake lever pins. All other moving parts should be lubricated with oil can. Whenever brake rod has been removed from loom, inside of loom must be lubricated before reinstalling rod. Refer to LUBRICATION (SEC. 13) for all lubrication instructions.

Brake Specifications

AIR BRAKES

	FRONT	REAR
BRAKE SIZE	14-1/2 x 5	14-1/2 x 8
BRAKE DRUM		
Diameter	14.490"-14.510"	14.490"-14.510"
Maximum Allowable Out-of-round	0.010"	0.010"
Machining Limits (beyond original diameter)	0.125"	0.125"
BRAKE LINING		
Length - Each Piece (2 pieces per shoe)	7.33"	7.33"
Width	5"	8"
Thickness	3/4"	3/4"
Area Per Wheel	147 sq. in.	235 sq. in.
BRAKE SHOE RETURN SPRING		
Free Length	8-11/16"	8-1/2"
Length (in. @ lbs. pull)	9-13/32 @ 32-38	9-13/32 @113-137
CAMSHAFT		
Diameter at Bearings	1.493"-1.495"	1.493"-1.495"
CAM ROLLER IN SHOE		
Large Diameter	1.488"-1.492"	1.488"-1.492"
Small Diameter	0.745"-0.740"	0.745"-0.740"
ANCHOR PINS AND BUSHINGS		
Pin Diameter at Shoe	1.2473"-1.2488"	1.2475"-1.2490"
Pin Length	4-3/8"	6-5/16"
Diameter of Hole in Shoe	1.251"-1.254"	1.251"-1.254"
BRAKE CHAMBERS		
Type	"24"	"30"
Diameter (overall)	7-1/4"	8-1/8"
Spring Force at 0 Stroke	30-3/4 lbs.	39-1/2 lbs.
Spring Force Increase per Inch of Stroke	9 lbs.	10-1/2 lbs.
Maximum Stroke	2-1/4"	2-1/2"
Minimum Stroke (With brake adjusted)	Short as possible	without brakes dragging.
SLACK ADJUSTERS		
Type	"20-2"	"20-2"
Length (Between hole centers)	5"	6"
Lever Bushing I.D.	0.501"-0.504"	0.501"-0.504"
BRAKE APPLICATION VALVE		
Type		"D-1"
Operating Lever Bushing I.D.		0.501"-0.504"
Lever Shaft O.D.		0.7470"-0.7475"
Lever Shaft Bushing I.D.		0.749"-0.750"
Roller Pin O.D.		0.3105"-0.3125"
I.D. of Hole in Roller		0.313"-0.316"

BRAKE SPECIFICATIONS

AIR COMPRESSOR

Make	Bendix-Westinghouse
Model	TU-FLO "500"
Capacity (at 1250 RPM)	12 cu. ft.
Inlet Valve Seat	
Worn Groove Not to Exceed	0.003"
Discharge Valve Seat	
Worn Groove Not to Exceed	0.003"
Piston Ring Gap (in Cylinder)	0.005"-0.015"
Piston Ring Clearance (in Groove)	
Narrow Ring	0.002"-0.004"
Wide Ring	0.0035"-0.0055"
Pin Clearance (in Piston)	0.0000"-0.0002"
Clearance Between Piston and Cylinder Wall	0.002"-0.004"
Cylinder Bores	
Maximum Allowable Out-of-round	0.002"
Maximum Allowable Taper	0.003"
Crankshaft Seal Ring Gap (in Crankshaft)	0.008"-0.015"
Crankshaft Journal Maximum Out-of-round	0.001"
Clearance Between Connecting Rod Bushing and Piston Pin (Ream)	0.0001"-0.0006"
Maximum Allowable Clearance	0.0015"
Discharge Valve Travel with New Valves, Springs and Cap Nuts - Between	0.056"-0.070"
Clearance Between Connecting Rod Bearing and Crankshaft Journal (after Rebuild)	0.0003"-0.0021"
Inlet Valve Spring	
Free Height	29/64"
Height Under Load of 3/8"	@ 2.7 oz. to 3.3. oz.
Discharge Valve Spring	
Free Height	1-7/64"
Height Under Load of	1.072" @ 1/4 lbs. to 3/4 lbs.
Unloader Valve Spring	
Free Height	11/16"
Height Under Load of	9/16" @ 5 lbs. 6 oz. to 6 lbs. 10 oz.

GOVERNOR

Make	Bendix-Westinghouse
Model	"D"
Cut-Out Pressure	100-105 psi
Cut-in Pressure	80-85 psi
Pressure Range	20 psi

HAND BRAKE

Type	Two-Shoe External Contracting
Drum Diameter (Outside)	11"
Brake Shoe Lining	
Width	6"
Thickness	5/8"
Brake Shoe Anchor Pin Bushings	
I. D. (Burnish After Assembly)	1.7505"-1.7485"
O. D.	Press fit in shoe
Length	1-7/32" - 1-15/64"
Diameter of holes in shoe	1.8755"-1.8735"
Brake Shoe Lever Pin Bushings	
I. D. (Burnish after assembly)	0.6265"-0.6245"
O. D.	Press fit in shoe
Length	1-1/32" - 1-3/64"
Diameter of holes in shoe	0.7505"-0.7485"
Anchor Pin	
Diameter (at bushings)	1.748"-1.746"
Length (overall)	11-1/4"
Brake Shoe Lever Pin	
Diameter	0.6235"-0.6225"
Length	
Upper	2"
Lower	4-1/4"

Clutch

Clutch (fig. 2) is single plate dry disc type, manually controlled (disengaged and engaged) by foot-operated pedal and linkage (fig. 1).

Clutch disc assembly (driven member) is splined to transmission main drive gear. Two facings are riveted to driven disc and these facings are held tightly between friction surface on pressure plate and flywheel plate when clutch is engaged.

CLUTCH CONTROLS

Clutch pedal lever hinges on hand brake cross shaft at rearward end. Clutch control cross shaft is supported in bushings held in place by brackets. Cross shaft has a lever installed at each end. A short link connects cross shaft outer lever to clutch pedal lever. Lever at inner end of cross shaft is connected to forward end of clutch control rod assembly which runs to rear of coach. Pedal return spring is attached to clevis pin at forward end of clutch control rod and bracket at transmission control shift tower. Clutch control rod is enclosed in a loom held in brackets beneath coach floor. Rods and loom are protected by covers.

Rearward end of control rod is connected to a bell crank on rearward side of engine compartment bulkhead. Bell crank and linkage transmit control rod movement to clutch operating lever at clutch housing.

OPERATION

Key numbers in text refer to figure 2.

When clutch is in engaged position, springs (27) exert force against pressure plate (3) clamping driven disc assembly (41) against flywheel clutch plate (42). Crankshaft (38) is thus connected to transmission by driven disc assembly (41) and transmission main drive gear (16).

When clutch is disengaged, release yoke (21) operated by pedal, moves release sleeve (22) which forces release bearing (15) against inner ends of levers (13). Resultant force at outer ends of levers (13), which are pivoted on pins (6 and 7) in the pressure plate and adjusting yoke, overcomes the force exerted by clutch springs (27) and retracts pressure plate (3), thus releasing clutch.

1 Lever Return Spring
2 Hand Wheel
3 Rear Control Rod
4 Bell Crank
5 Engine Compartment Bulkhead
6 Control Rod Bellows
7 Grommet
8 Transmission Shift Tower Bracket Assy.
9 Clutch Control Rod
10 Hand Brake Cross Shaft
11 Pedal Return Spring
12 Link
13 Clevis Pin
14 Clutch Control Cross Shaft
15 Floor
16 Pedal Lever
17 Adjustable Collar
18 Clutch Pedal

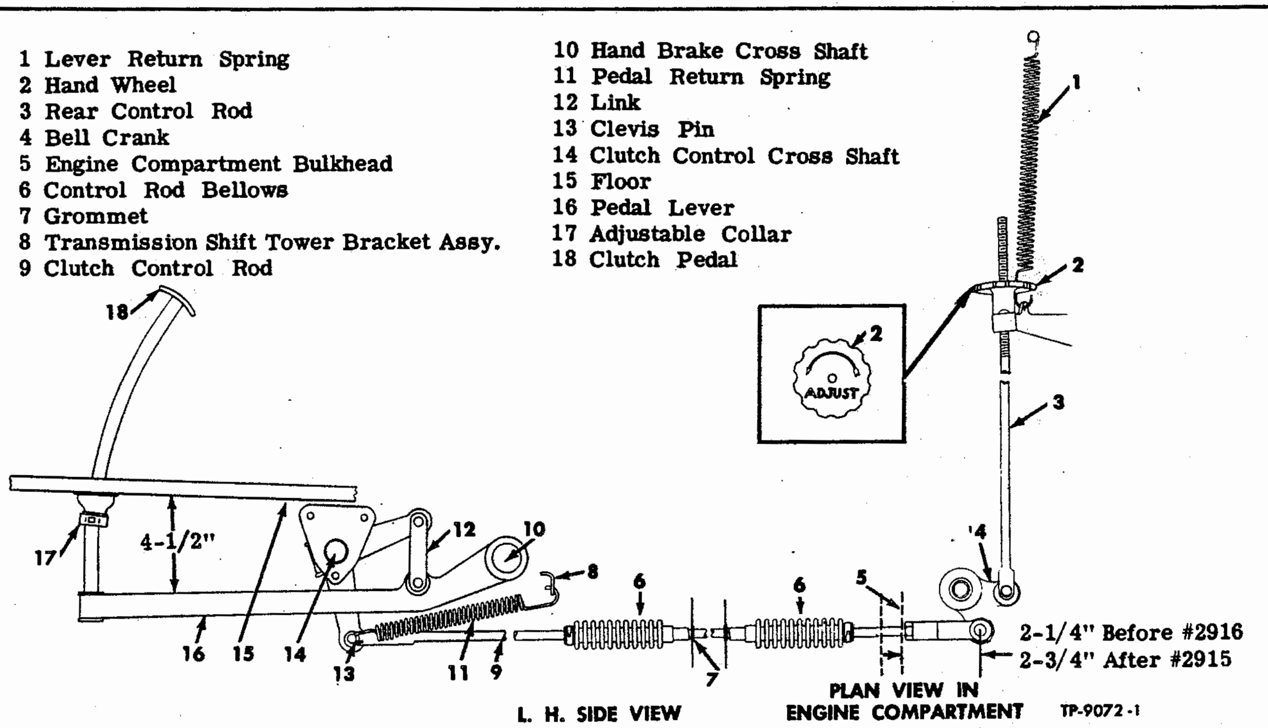
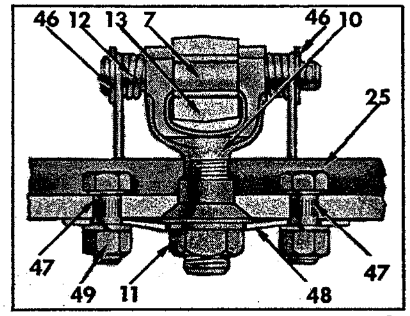
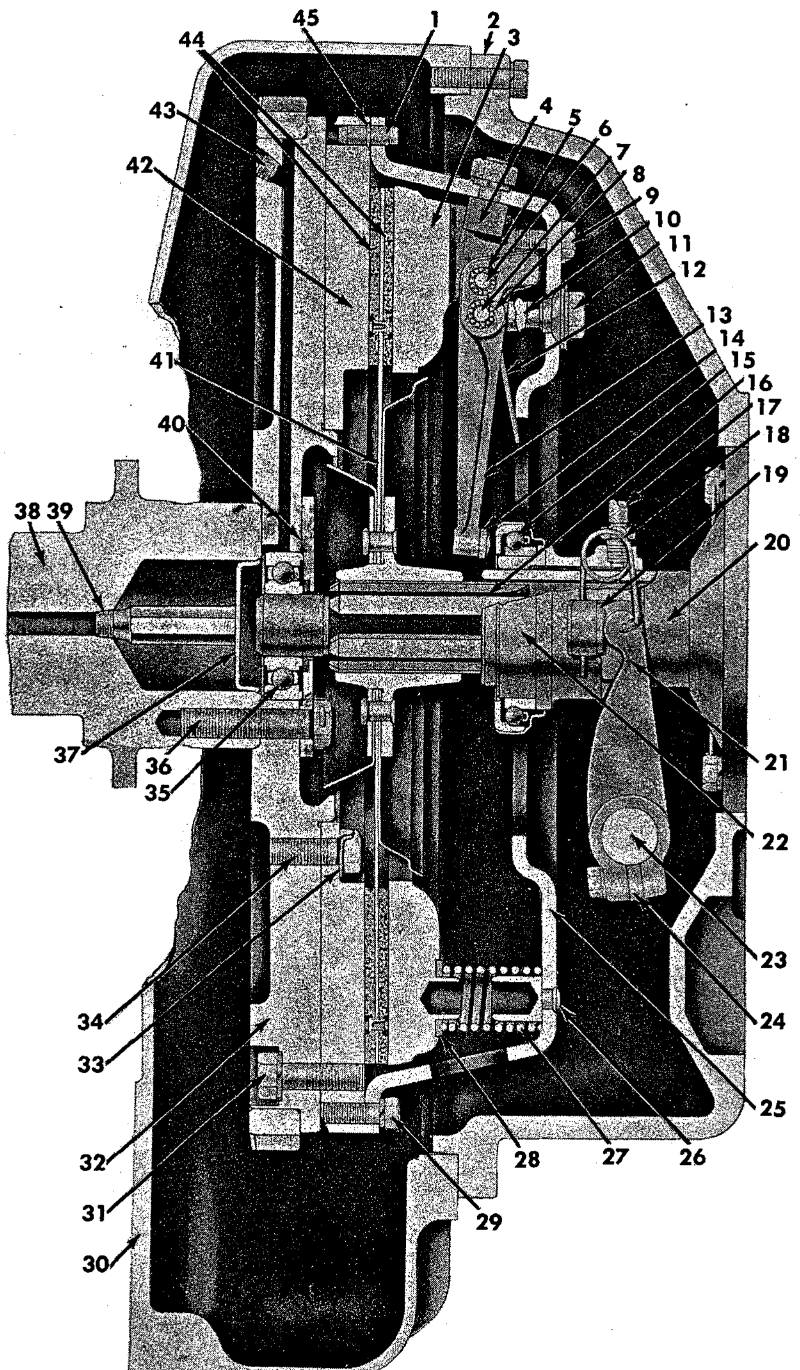


Figure 1—Clutch Control Linkage



RELEASE LEVER ADJUSTING YOKE



1 Dowel Pin
2 Clutch Housing
3 Pressure Plate
4 Drive Block
5 Needle Bearings
6 Release Lever Pin
7 Lever to Yoke Pin
8 Needle Bearings
9 Shipping Bolt (Cap Screw)
10 Adjusting Yoke
11 Yoke Adjusting Nut
12 Release Lever Spring
13 Release Lever
14 Lever Thrust Button
15 Clutch Release Bearing
16 Transmission Drive Gear
17 Lubrication Tube
18 Release Bearing Return Spring
19 Sleeve Thrust Button
20 Transmission Bearing Cap
21 Release Bearing Yoke
22 Release Bearing Sleeve
23 Clutch Shifter Shaft
24 Shaft Lock
25 Clutch Cover Plate
26 Spring Guide
27 Pressure Spring
28 Spring Insulator
29 Cover to Flywheel Bolt
30 Flywheel Housing
31 Flywheel Plate Cap Screw
32 Engine Flywheel
33 Bolt Lock
34 Plate to Flywheel Screw
35 Pilot Bearing
36 Flywheel to Crankshaft Bolt
37 Baffle
38 Engine Crankshaft
39 Plug
40 Pilot Bearing Retainer
41 Driven Disc Assembly
42 Flywheel Plate
43 Lubrication Plug
44 Clutch Facings
45 Dowel Snap Ring
46 Flat Washer
47 Thrust Plate Bolt
48 Thrust Plate
49 Thrust Plate Bolt Nut

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Figure 2—Clutch Assembly

CLUTCH CONTROL MAINTENANCE

Key numbers in text refer to figure 1.

1. Be sure all pivot points in control linkage are lubricated according to instructions given in LUBRICATION (SEC. 13).

2. Check dimension between clutch pedal lever and under side of floor. If necessary to provide the 4-1/2 inch dimension (fig. 1), move the adjustable collar (17) which is held in place by set screw.

3. Always use return springs (1 and 11) as specified in Parts Book.

4. When replacing control rod (9), rod end clevises, or bell crank (4), adjust rod end clevises so that center of pin hole in bell crank (4) is distance from bulkhead shown in figure 1. This will give best leverage for disengaging clutch with light pedal pressure.

CAUTION: Always check pedal free-travel and adjust to 1-1/2" after replacing control linkage parts or making other adjustments.

CLUTCH ADJUSTMENTS

Three adjustments are provided at clutch assembly and control linkage. The only adjustment normally required, however, is that necessary to maintain proper clutch pedal free-travel. The two other adjustments, one to control pedal lever to floor clearance, and the other for setting clutch lever position are required only when replacing parts of clutch or pedal linkage and are covered in the procedures for assembling the respective parts.

PEDAL FREE-TRAVEL ADJUSTMENT (Fig. 1)

Need for pedal free-travel adjustment (defined as first easy movement of clutch pedal) is indicated when inspection shows free-travel movement to be less than 1-1/2".

Operating vehicle without sufficient clutch pedal free-travel will result in excessive wear at release bearing and also will cause clutch slippage.

The gradual reduction in amount of pedal free-travel is a normal condition caused by wearing of driven member facings. Nut (hand wheel) in engine compartment provides a means of adjustment. Adjust as follows:

1. Turn adjusting nut (hand wheel) sufficiently to lengthen bell crank to lever distance to provide the 1-1/2" free-travel.

NOTE: Check pedal free-travel with hand on pedal rather than with foot as the adjustment is sensitive.

2. Be sure that return spring at lever in engine compartment is in good condition as spring holds lever against nut to lock adjustment.

3. Make periodical inspection of clutch mechanism through inspection hole in bottom of clutch housing. When clutch levers near the edge of inner rim of cover the clutch disc facings should be replaced.

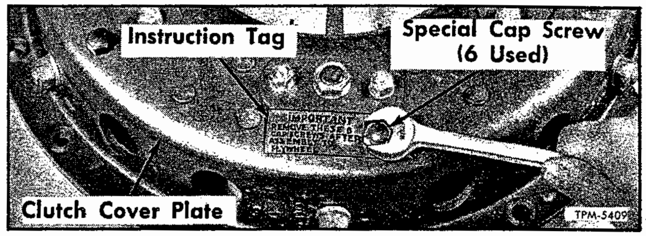


Figure 3—Temporary Cap Screws and Instruction Plate

CLUTCH REMOVAL

Key numbers in text refer to figure 2.

Before removing clutch, transmission must be removed as instructed in TRANSMISSION (SEC. 17). Then proceed as follows:

1. Install six special cap screws (3/8"-16 x 1-1/2", threaded 1") through holes in cover plate (25) located directly above each release lever (13) (fig. 3). Turn screws into pressure plate (3) as far as possible. This procedure relieves pressure spring (27) load so cap screws (29) can be easily removed.

2. Install aligning arbor (B-80-0062) or old clutch shaft to support driven disc when removing clutch cover assembly.

3. Remove cover bolts (29) meanwhile supporting clutch to prevent distortion of clutch dowels (1). Tap flange of clutch cover with soft mallet to free assembly from flywheel. Remove clutch assembly and driven disc.

4. Remove bolts (36) and remove retainer (40) which retains pilot bearing (35) in flywheel. After retainer is removed, install two bolts to hold flywheel on crankshaft while removing pilot bearing.

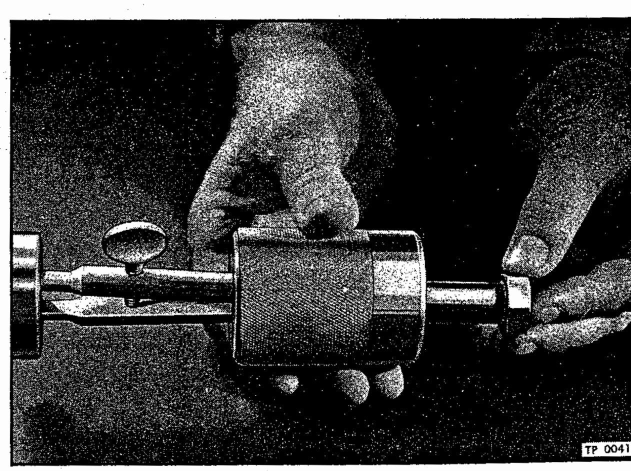
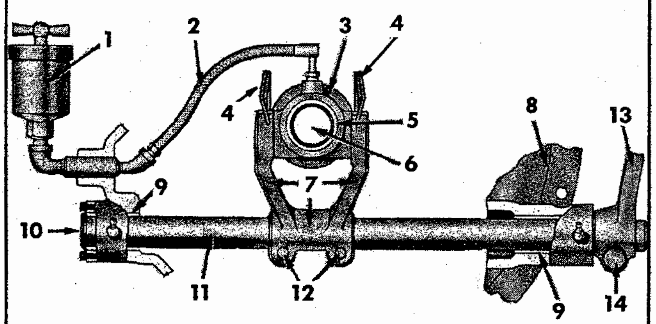


Figure 4—Pilot Bearing and Removal Tool



1 Grease Cup
2 Lubrication Tube
3 Release Sleeve
4 Release Sleeve Spring
5 Transmission Bearing Retainer
6 Drive Gear (Clutch Shaft)
7 Release Yoke
8 Clutch Housing
9 Shifter Shaft Bushing
10 Shaft Cover
11 Clutch Shifter Shaft
12 Yoke Clamp Bolts
13 Clutch Throw – Out Lever
14 Lever Clamp Bolt

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Figure 5—Release Mechanism at Clutch Housing

5. Remove pilot bearing using tool (B-80-0061) (fig. 4). Spread puller prongs in bearing by tightening thumb screw, then slide weight against stop nut to pull bearing.

RELEASE MECHANISM REMOVAL (Fig. 5)

1. Remove two hair pin springs connecting release bearing sleeve to release yoke. Disconnect lubrication tube from release bearing sleeve, then slide bearing and sleeve assembly off end of transmission bearing cap.

2. Remove two cap screws from release yoke and withdraw clutch shifter shaft from clutch housing.

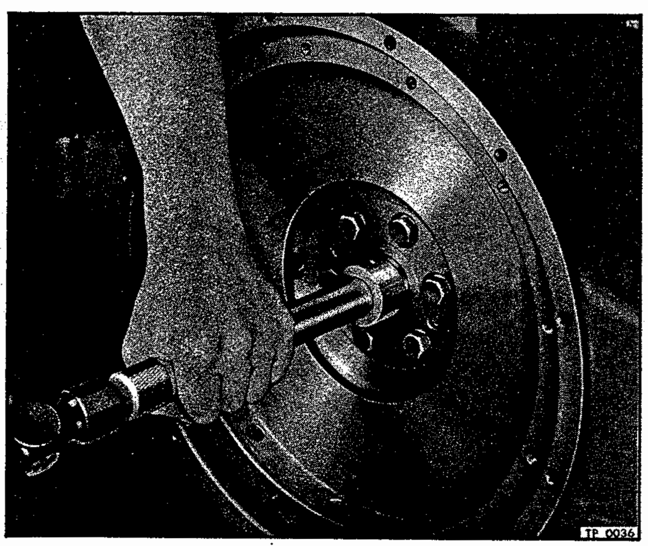


Figure 6—Pilot Bearing Installation

CLUTCH INSTALLATION

RELEASE MECHANISM

Key letters in text refer to figure 5.

1. Hold clutch release yoke (7) in position in clutch housing (8), then insert shifter shaft (11) through right-hand bushing (9), through yoke (7), and into left-hand bushing.

2. Install clamp bolts (12) and locks which locate yoke (7) on shifter shaft (11).

3. Install clutch release bearing and sleeve assembly (3) on transmission drive gear cap and connect lubrication tube (2). Install springs (4) which clip sleeve to yoke.

4. Install lever (13) on outer end of shifter shaft (11).

5. Check action of shifter shaft to ascertain if binding exists between yoke and release bearing sleeve. If these two parts touch at either side of sleeve, loosen yoke clamp bolts (12) and drive yoke to give equal clearance at each side sleeve.

6. Lubricate bushings (9) through fittings and turn down grease cup to force lubricant into release bearing.

PILOT BEARING INSTALLATION

1. Hand pack clutch pilot bearing with lubricant specified in LUBRICATION (SEC. 13). If flywheel has been removed from engine be sure grease baffle (37, fig. 2), is in place before installing flywheel and clutch pilot bearing.

2. Using driver to apply pressure at bearing outer race (fig. 6) drive pilot bearing into place in flywheel. Bearing race must bottom against shoulder in flywheel bore.

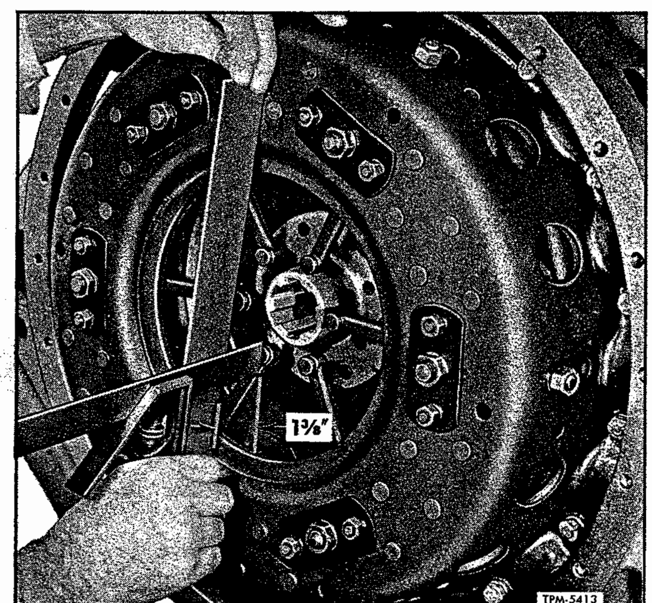


Figure 7—Checking Release Lever Position

3. Locate bearing retainer (40, fig. 2) against flywheel and install flywheel to crankshaft bolts. Tighten bolts to 150-160 ft. lbs. using torque wrench. Install lock wire through bolt heads.

COVER PLATE AND DRIVEN DISC

Key numbers in text refer to figure 2.

1. Put driven member (41) in place against flywheel plate (42) with short end of splined hub toward flywheel. Use aligning arbor (B-80-0062) or old clutch shaft to hold assembly in position.

2. Place clutch assembly in position against flywheel and install cap screws (29) using new lock washers. Tighten screws securely.

3. Remove six special cap screws (fig. 3) previously installed to facilitate clutch installation. Screws must be removed before clutch will engage.

4. Adjust yoke nuts (11) on yokes (10) so that contact button (14) of release lever (13) is 1-3/8" below face of clutch cover plate (25). Use straight edge and machinists square in manner illustrated in figure 7 when checking or making adjustment.

5. Each lever must be checked and adjusted individually and must be in the same plane within .030".

NOTE: Adjustment of release levers in relation to face of clutch cover is very important and must be held within limits in order to assure proper clutch action.

6. Install transmission as instructed in TRANSMISSION (SEC. 17) of this manual.

7. Adjust clutch controls as instructed under "Clutch Adjustments" previously in this section.

CLUTCH OVERHAUL

DISASSEMBLY

Key numbers in text refer to figure 2.

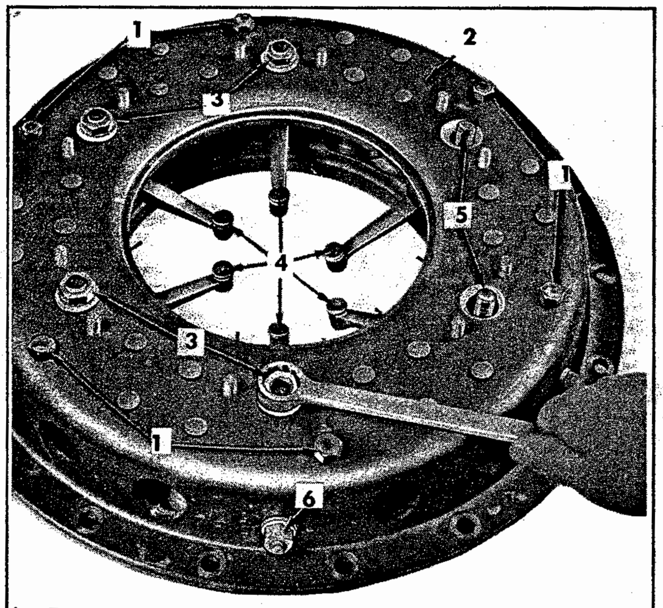
1. Remove nuts, washers, and thrust plate (48) used to lock each adjusting nut (11).

2. Remove adjusting nuts (fig. 8) from yokes. Special bolts will hold springs in compressed position while removing adjusting nuts.

3. Mark cover (25) and pressure plate (3) so that relative position will be known when reassembling; then remove six special cap screws (9), turning screws alternately and in gradual stages until spring pressure between cover and plate has been relieved. Lift clutch cover (25) off the pressure plate assembly.

4. Remove springs and insulators (27 and 28) from pressure plate bosses.

5. Remove cotter pins from release lever pins (6 and 7) and pull out pins. Be careful to note position of washers (28), springs (27) and number of rollers (5 and 8) so parts can be reassembled correctly. This completes disassembly of release levers (13), adjusting yokes (10) and pressure plate (3).



1 Special Bolts	4 Release Levers
2 Clutch Cover	5 Release Lever Yoke
3 Yoke Adjusting Nuts	6 Driving Block Nut

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Figure 8—Yoke Adjusting Nut Removal

INSPECTION

Prior to inspection, wash clutch parts (except driven disc facings) in clean gasoline or cleaning fluid. Refer to "Specifications" at end of this section for all clearances.

1. Inspect driven disc assembly for worn, loose or oil-soaked facings; for loose rivets at hub; for distortion. If disc is distorted, new driven disc and facings assembly should be used. DO NOT RELINE DISTORTED DISC. Refer to "Specifications" at end of this section.

2. To inspect release bearing, first soak in gasoline or cleaning solvent, tap sharply on wood block to dislodge dirt particles, flush in gasoline or cleaning solvent and blow dry by directing air at right angle to bearing, revolving slowly by hand. Examine bearing for pits and scores and, if usable, dip in clean oil. Do not disassemble bearings.

3. Inspect pressure plate and flywheel plate for checks and scores on contact surface. For refacing of pressure plate, see "Refacing Clutch Pressure Plate" under "Repair" later in this section. Flywheel plate can be refaced in similar manner.

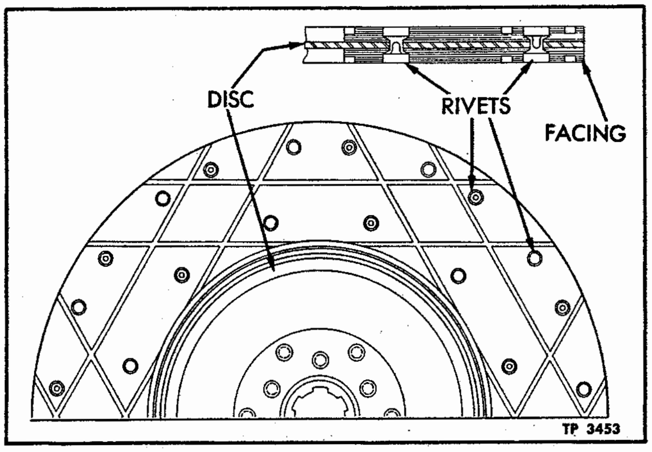


Figure 9—Clutch Disc Facing Rivet Pattern

4. Check clearance between driving blocks and slotted lugs in pressure plate. If there is indication of wear or scoring on driving blocks, replace same.

5. Clean and inspect rollers used at release lever pins. Replace if rollers show wear.

REPAIR

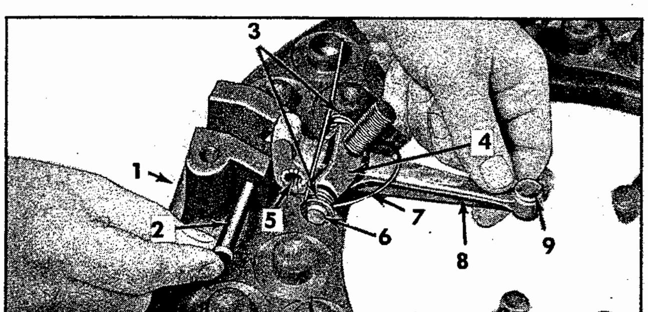
CLUTCH DRIVEN DISC AND FACINGS

In normal service, clutch facings wear evenly and last for a long time.

To replace facing, drill out facing rivets from head of smooth side of rivet. Use drill slightly smaller than rivet diameter. Rivet will turn if drilled from other side.

Support assembly during facing removal and installation to prevent distortion of disc.

DO NOT USE BRAKE RELINING MACHINE TO REMOVE RIVETS AS CLUTCH DISC WILL BE SPRUNG OR DISTORTED.



1 Pressure Plate	6 Yoke to Lever Pin
2 Lever to Pressure Plate Pin	7 Lever Spring
3 Flat Washer	8 Release Lever
4 Yoke	9 Release Lever Button
5 Bearing Rollers	

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Figure 10—Assembling Clutch Release Lever to Pressure Plate

Facings are interchangeable. When installing new facings, use genuine rivets and facings listed in GMC Parts Book.

Alternate rivets so that heads are in opposite directions as shown in figure 9.

Check over-all thickness of assembly after facings are installed. Test assembly for run-out. Disc should run true within limits given in "Specifications" at end of this section.

PRESSURE PLATE AND FLYWHEEL CLUTCH PLATE

Either the clutch pressure plate (3) or flywheel clutch plate (42), or both, if scored, or checked, can be refaced to produce a flat smooth surface. Before beginning resurfacing operation, measure thickness of parts. This is necessary to determine if parts have been resurfaced previously. Measure thickness of clutch pressure plate from front face to finished face of pressure spring seat. Be sure insulating washers (6 fig. 11) have been removed.

To refinish flywheel plate, remove the flywheel assembly from engine and perform machining operation with plate bolted to flywheel. Shim washers 1/32" thick are available for use when assembling clutch after resurfacing clutch pressure plate. Therefore, when resurfacing this plate, at least 1/32" of stock should be removed at a time. This will permit the use of the 1/32" shims and thereby maintain torque capacity of clutch. No shims are required to compensate for metal removed from plate on flywheel. Do not reduce the original thickness of either plate more than 3/32". Original thickness of each part is given in "Specifications" at end of this section.

No more than three 1/32" shims should be used under each pressure spring when building up clutch cover and pressure plate assembly.

CLUTCH HOUSING AND DOWEL PINS

Two dowel pins, held in clutch housing with snap rings, locate clutch housing on main transmission case. In production, clutch housing is bolted to main case with drive shaft bearing retainer in place. The dowel pin holes in both case and housing are then line reamed, and dowels installed. A finish cut is then taken on shoulder of clutch housing to align housing concentric with transmission mainshaft.

Service clutch housings are machined in same manner before shipment except that dowel pin holes are left under-sized. Bolt new clutch housing to main case as explained. Line ream dowel holes and install dowels and snap rings. Concentricity and squareness of clutch housing flanges should be within limits listed in "Specifications" at end of this section.

ASSEMBLY

Key numbers in text refer to figure 2.

1. Assemble adjusting yokes (10) and springs on clutch release levers as follows:

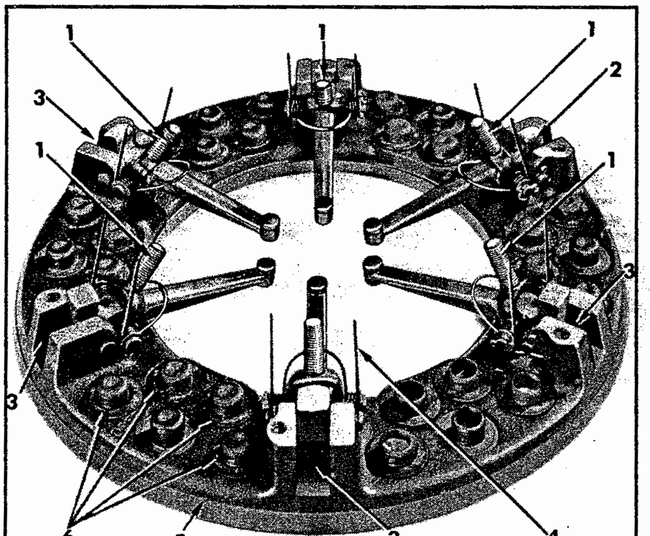
a. Make two pilot pins slightly shorter than needle rollers and same diameter as pins (6 and 7). Chamfer ends of pilot pins.

b. Lay lever (13) on flat surface and insert a pilot pin in each hole. Apply light coat of release bearing lubricant on needle rollers referring to LUBRICATION (SEC. 13) for correct lubricant. Insert rollers (5 and 8) around pilot pins, then put adjusting yoke (10) in position with spring (12) straddling yoke. Place flat washer (46) on pin (7) then push pin through spring, yoke, and lever, thereby pushing out pilot pin. Assemble washer (46) and cotter pin to retain pin (7).

c. Position lever and yoke assembly at pressure plate, then install pin (fig. 10) and retain with cotter pin.

d. Repeat procedure described in steps b. and c. above to assemble each lever to pressure plate.

2. Place pressure plate and levers assembly (fig. 11) face downward on bench. If the pressure plate has been resurfaced, place 1/32-inch shims between insulating washers (28) and spring bosses on pressure plate. Use one shim for each 1/32" of material removed during resurfacing operations. Refer to figure 12 for proper position of springs on pressure plate.



1 Release Lever Yoke
2 Release Lever
3 Drive Block Slots
4 Lever Spring
5 Pressure Plate
6 Insulating Washer

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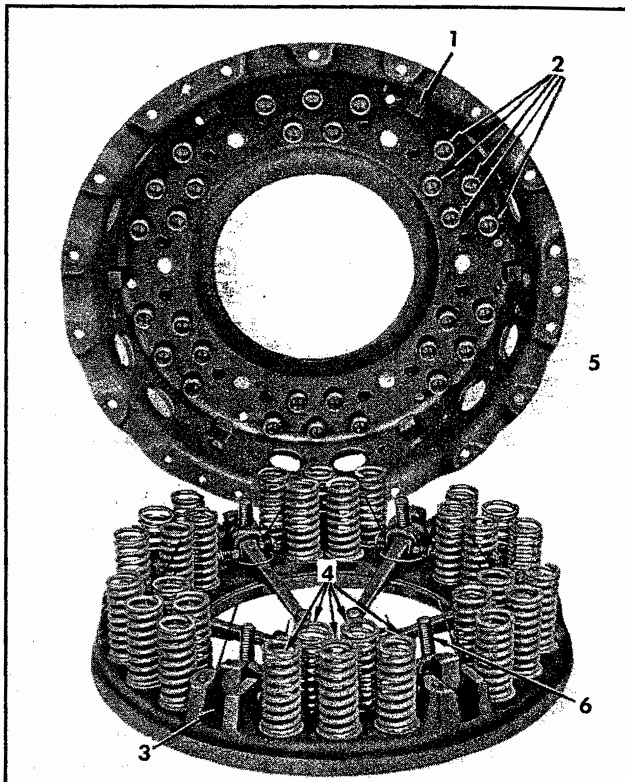
Figure 11—Pressure Plate and Release Levers



1 Drive Blocks
2 Spring Guides
3 Drive Block Slots
4 Pressure Springs
5 Clutch Cover Assembly
6 Release Lever Yoke

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Figure 12—Spring Arrangement on Pressure Plate

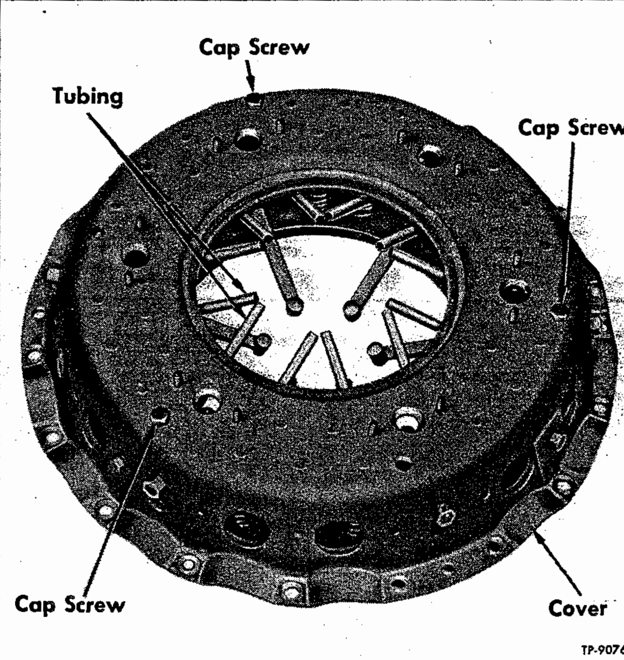


Figure 13—Installing Cover Plate on Pressure Plate

CLUTCH

3. When insulating washers (28) and springs (27) are in position, set cover (25) over springs (27), fitting each spring guide (26) on cover into corresponding spring. Cover must assume original position in relation to pressure plate. Refer to alignment marks made at disassembly to determine correct position. Drive blocks (4) must enter slots in pressure plate.

4. See that ends of springs (12) do not catch under cover, pieces of tubing 3/8 inch by 4-1/2" long may be placed on spring ends shown in figure 13, to guide ends of springs past cover.

5. Install three long cap screws, 3/8" - 16 x 2", fig. 13) through holes in cover plate, starting each screw into tapped hole in pressure plate, then tighten special screws alternately and in gradual stages to compress springs (27) and bring threaded ends of yokes (10) into respective holes in cover plate. Guide yokes through holes as cap screws are tightened.

6. Thread adjusting nuts (11) onto yokes (10) so that end of yoke is approximately flush with top of nut.

7. Install adjusting nut thrust plates (48) tightening plate retaining nuts (49) firmly.

8. Remove three long cap screws shown in figure 13, that were installed in step 5.

9. Install six short, cap screws (fig. 3) (3/8" -16 x 1-1/2") through holes in cover plate (25) located directly above each release lever (13).

10. Clutch assembly now is completely built up and ready to be assembled to flywheel. Short cap screws (fig. 3) must remain in place until cover to flywheel screws have all been installed, then they must all be removed to allow clutch springs (27) to operate.

SPECIFICATIONS

Make . . . . Long
Type . . . . Single Plate Dry Disc

Driven Member and Facings
- Facings
  - Quantity 2
  - Outside Diameter . . . . 16-3/4"
  - Inside Diameter . . . . 10"
  - Thickness Each Facing . . . . 0.184"-0.190"
- Disc and Facings - Total Thickness . . 0.457"
- Driven Disc Run-Out - Taken at 7-1/2" Radius on Flywheel Side- Not to Exceed 0.035"

Clutch Pressure Springs
- Type . . . . Coil Compression
- Number Used 30
- Free Length . . . . 2.843"
- Lbs. Pressure @ 1.950" . . 127-1/2 - 132-1/2

Release Lever Tension Spring
- Free Position . . . . . 45^{o} from Horizontal
- Number Used 6

Clutch Pressure Plate
- Original Thickness . . . . 15/16"
- Reface to Not Less Than . . . . 27/32"

Flywheel Clutch Plate
- Original Thickness . . . . . 0.870"-0.890"
- Reface to Not Less Than . . . . 25/32"
- Outside Diameter . . . . 19-3/8"
- Bore . . . . 7.5005"-7.5015"
- Dowel Ream . . . . 0.3732"-0.3739"

Clutch Release Bearing and Support
- Type . . . . Ball

Clutch Pilot Bearing
- Type . . . . Ball

Clutch Yoke and Shifter Shaft
- Clearance - Between Yoke and Release Bearing Support . . . . . . Equal Both Sides
- Shifter Shaft Diameter . . . 1.1250" - 1.1235"

Clearance Between
- Cover Plate Drive Blocks and Pressure Plate . . . . . . 0.008" - 0.013"
- Driven Disc Hub and Transmission Main Shaft Spline . . . . . 0.005" - 0.003"

Clutch Adjustment
- Pedal Free Travel (See Instructions) . 1-1/2"
- Release Levers to Face of Clutch Cover 1-3/8"
- Levers in Same Plane Within . . . . . 0.030"

Transmission Clutch Housing Pilot Hole
- Run-Out Not to Exceed . . . . 0.001"

Clutch Housing Pilot Flange Run-Out
- Not to Exceed . . . . 0.002"

Clutch Housing Squareness
- Rear Housing Rear Face Square with Crankshaft Within 0.010" total indicator reading checked at 3-5/8" radius.

Cooling System

This group includes sections covering Maintenance Information on "COOLING SYSTEM - GENERAL," and "RADIATOR, SHUTTERS, AND THERMOSTAT."

Cooling System—General

Engine is liquid cooled by means of a pressure-type system. System is filled through filler neck located in surge tank mounted in body above radiator. Pressure valve (fig. 1) is installed at top of surge tank. Manually operated valves, accessible after opening surge tank filler door, are provided to relieve pressure and for checking coolant level. Radiator is equipped with automatic shutters which are actuated by power unit connected to compressed air line. A six-bladed fan mounted on hub at front end of engine crankshaft (fig. 6) draws air through radiator core when shutter is open. Thermostats shown in figure 2 serve to direct circulation of coolant; and shutter thermostat incorporates an air valve which con-

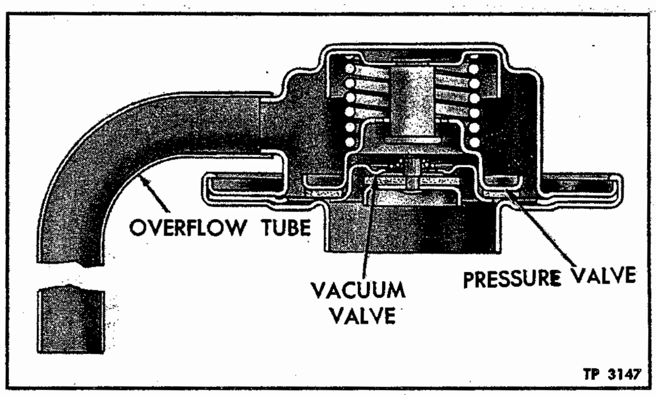


Figure 1—Cooling System Pressure Valve

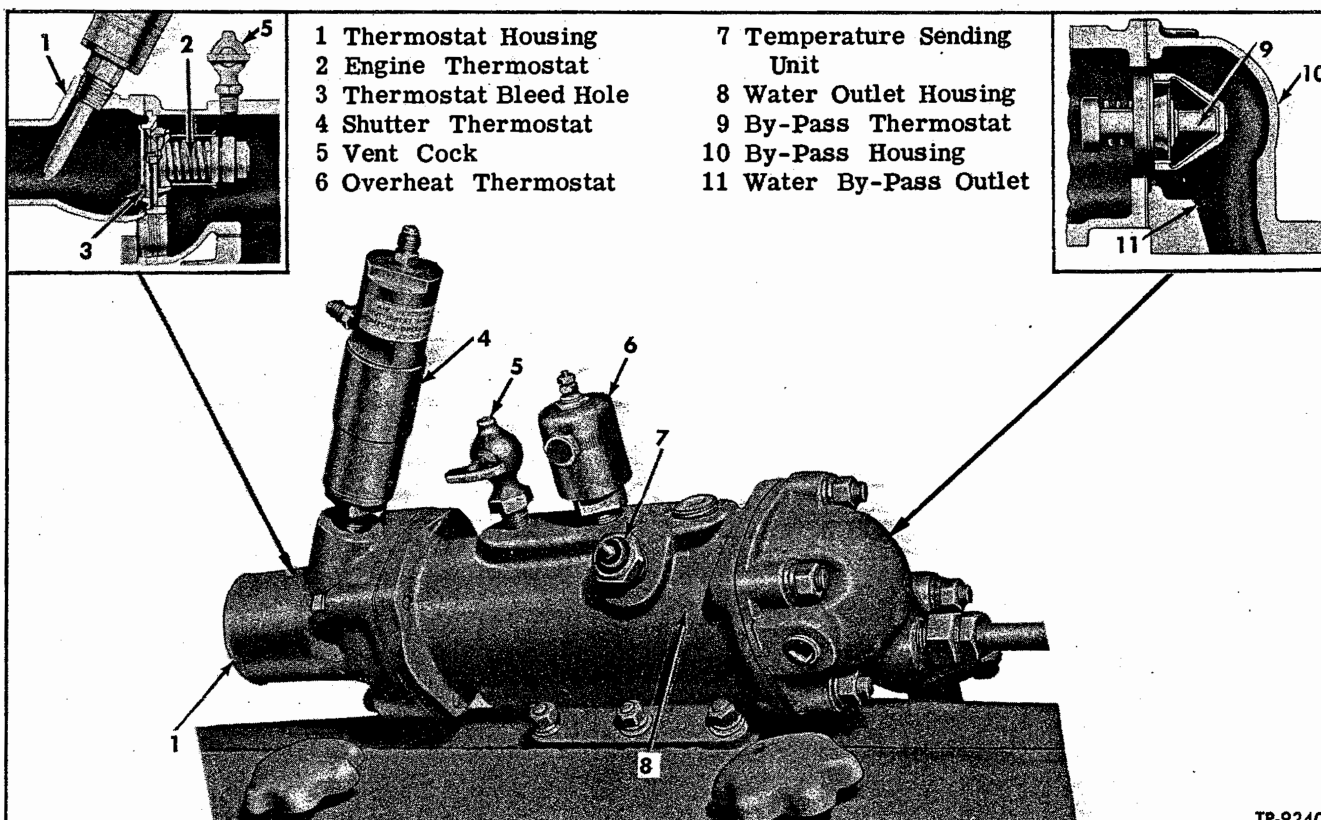


Figure 2—Engine Water Outlet Housing and Control

trols radiator shutters. A thermal switch (overheat thermostat 6, fig. 2) signals driver in case temperature becomes too high. Engine temperature is registered on temperature gauge in driver's instrument panel. Gauge is electrical type actuated by sending unit (7, fig. 2) at engine.

CIRCULATION

Coolant within system is force-circulated by engine water pump. The circulation during engine warm-up period differs from circulation after engine has reached normal operating temperature as explained in following paragraphs.

WARNING: On vehicles equipped with standard GM air conditioning it is imperative that gate valves in heater lines at engine bulkhead be left open during summer, since air conditioning engine is cooled from heater lines.

ENGINE WARM-UP

Key numbers in text refer to figure 2.

Water by-pass thermostat (9) is reverse-acting type in which spring holds valve open when temperature is below 170°F. When cold engine is started, thermostat (2) is closed and coolant cannot flow to radiator; consequently, coolant is forced through heater supply line through heating system and returns through engine oil cooler to suction side of water pump. At the same time coolant is recirculated through engine passages and returned to pump through by-pass tubes. As coolant temperature rises, the water by-pass thermostat closes and thermostat (2) at front of outlet housing opens, coolant begins to circulate as described in following paragraph.

AFTER WARM-UP

Key numbers in text refer to figure 2.

After coolant has reached a temperature at which thermostat (2) opens, by-pass thermostat will have closed so that only the coolant returning from air compressor flows to water pump through by-pass tubes. Coolant continues to circulate through coach heating system as described in preceding paragraph and coolant passing thermostat (2) passes into radiator where it is cooled by air drawn through core by action of fan. Cooled liquid combines with coolant from heater line and flows through oil cooler to water pump. Refer to "Radiator, Shutters, and Thermostat" later in this section for information on radiator shutters and control units. Some vehicles are equipped with water filters which have inlet line connected to water pump and outlet line returns filtered liquid to connector at engine oil cooler. Refer to "Cooling System Maintenance" later in this section for procedure to service water filter.

DRAINING COOLING SYSTEM

Heating system and engine cooling system can each be drained separately from the other by closing two gate valves, one in each heater line. Valves are located at engine compartment bulkhead near radiator.

Press and hold pressure relief valve button until all pressure and steam have been released. Open surge tank filler cap, then open drain cocks or remove drain plugs at points listed below.

COOLING SYSTEM DRAIN POINTS

The following points must be opened to completely drain engine cooling system:

1. Open drain cock at bottom of engine water pump housing.
2. Remove drain plug from radiator outlet connection, located at left rear corner of vehicle.
3. Remove hollow-head drain plug from side of air compressor cylinder head.
4. Refer to "HEATING AND VENTILATION" (SEC. 3) for instructions when draining heating system.

FILLING COOLING SYSTEM

Only pure soft water, recommended inhibitors, and ethylene glycol anti-freeze should be used in the cooling system. Refer to "Corrosion Damage Prevention," later in this section for additional information.

REPLENISHING SYSTEM

Coaches are equipped with a push-button type pressure relief valve and tube. Valve is installed at left of filler cap, and is accessible after opening the surge tank filler door (fig. 3).

CAUTION: Avoid injury from hot water or steam by following instructions in sequence given.

1. Press relief valve button (fig. 3) and hold depressed until all pressure in system is relieved.
2. As an added precaution, lift surge tank filler cap handle only to first or safety stage, standing clear to prevent burns from existing steam. After making sure all steam has escaped, trip catch and open filler cap (fig. 3).

IMPORTANT: If engine is overheated, do not add cold water immediately. Wait until boiling has stopped and engine has cooled off; then add coolant with engine running.

3. With engine running, add coolant until liquid flows from level cock in surge tank (fig. 3). When closing filler cap, make sure safety catch engages edge of cap.
4. If water level was very low, bleed heating system to make sure all air is expelled. Refer to "HEATING AND VENTILATION" (SEC. 3).

NOTE: On vehicles equipped with standard GM air conditioning, open vent cock to bleed air from air conditioning engine as explained under "HEATING AND VENTILATION" (SEC. 3).

FILLING EMPTY SYSTEM

When system has been completely drained, use following procedures to insure proper filling.

1. If heating system was not drained, open gate valves in heater lines; valves are located at engine compartment bulkhead near radiator. If heating system was drained, make sure all drain cocks and vent cocks in heating system are closed. Refer to "HEATING AND VENTILATION" (SEC. 3).

2. Make sure drain cock at bottom of water pump is closed, and that drain plugs are installed in bottom of radiator outlet connection and in air compressor cylinder head.

3. Open vent cock (fig. 2) on top of engine thermostat housing; and open level cock at surge tank (fig. 3).

4. Add coolant through surge tank filler neck until liquid begins to flow from thermostat housing vent cock, then close vent cock. Continue adding coolant until liquid flows from level cock at surge tank.

5. On vehicles equipped with booster water pump, lift switch (fig. 3) for approximately 30 seconds. Booster pump will circulate water through the heating system and expel air from system. Add additional water to bring level of coolant up to level cock (fig. 3).

6. On vehicles not equipped with booster water pump, start engine and run at a fast idle until normal operating temperature is attained. On vehicles equipped with standard GM air conditioning bleed air from system as directed in "HEATING AND VENTILATION" (SEC. 3).

7. Reduce engine speed to normal idle.

CAUTION: To avoid injury, always press and hold relief valve button (fig. 3) until pressure is released before opening filler cap.

8. Open filler cap and replenish system to level cock, then close level cock tightly.

CLEANING SYSTEM

Unless water in cooling system is equipped with a water filter or is treated with a corrosion preventive, rust and scale may eventually clog water passages in radiator and jackets. This condition is aggravated in some localities by the formation of insoluble salts from minerals in the water.

Cleaning solutions are available which will successfully clean cooling systems of rust, scale, sludge, and grease, when used as directed by the manufacturer. However, if radiator is clogged with

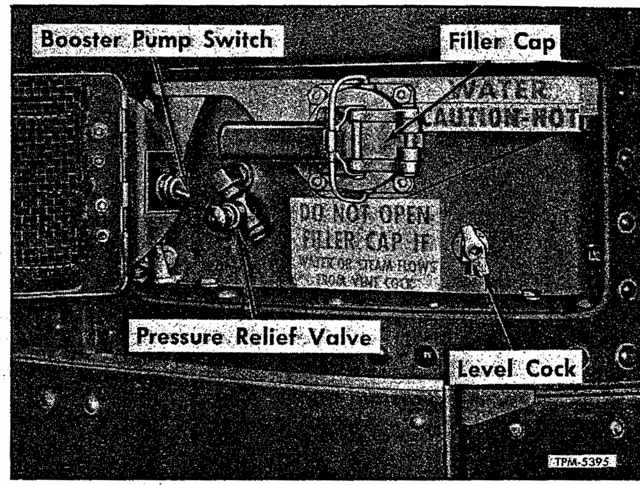


Figure 3—Cooling System Units at Surge Tank

insoluble scale formations, reliable radiator service stations in the various localities are best equipped to remove such formations. Never use an alkaline type cleaner. Particularly at winter check-up, preferably before and after using anti-freeze solutions, radiator and entire cooling system should be cleaned with a reliable cleaning solution.

NOTE: Always follow instructions by manufacturer of cleaning solution and equipment used.

Before pressure-flushing cooling system, tighten cylinder head bolts to prevent possible water leaks into cylinder and lubricating oil. Remove thermostat. Apply air gradually, as a clogged radiator will stand only limited pressure.

After cleaning operation is completed, be sure to check and test engine thermostats. Clean out overflow pipe and blow insects and dirt from radiator air passages and grille.

COLD WEATHER OPERATION

In cold regions, anti-freeze must be used in cooling system to prevent damage by freezing. Before installing anti-freeze solution, cooling system should be inspected and serviced as previously described under "Periodic Inspection" and "Cleaning System."

Tighten cylinder head bolts and, if necessary, replace gasket, to prevent leakage of anti-freeze into engine and blowing of exhaust gases into cooling system.

THAWING COOLING SYSTEM

If coolant freezes solid, place coach in a warm building until ice is completely thawed.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD ENGINE BE RUN WHEN COOLING SYSTEM IS FROZEN SOLID.

ANTI-FREEZE SOLUTIONS

Only ethylene-glycol type anti-freeze solution is recommended for use in vehicles equipped with radiator shutters. Ethylene glycol solutions have the advantage of a higher boiling point and may be used at higher temperature without loss, resulting in more efficient performance of cooling system. Ethylene-glycol has the further advantage that, in a tight system, only water is required to replace evaporation losses. However, losses through leakage or foaming must be replaced by additional new solution. Under ordinary conditions, ethylene-glycol solutions are not injurious to body finish. GM Ethylene-Glycol anti-freeze is especially treated and compounded. Other ethylene-glycol preparations are available, but only those containing suitable corrosion inhibitors and compounded for use in automotive cooling systems should be used.

Testing Anti-Freeze Solution

Always test solution before adding water or anti-freeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature. Other testers are provided with thermometers and tables and indicate freezing points corresponding to readings made at various temperatures. Disregarding temperature of solution may cause an error as large as 30°F.

Some testing devices are made to test only one kind of anti-freezing solution. Others have several scales, and may be used for corresponding kinds of anti-freeze. Read, and be guided by, instructions furnished with tester.

COOLING SYSTEM INSPECTION AND MAINTENANCE

PERIODIC INSPECTION

At regular intervals, cooling system units should be inspected to determine if service is required. Regular systematic checks will indicate condition of various units and necessity of servicing or replacement of units which can be made before failures occur.

1. At surge tank, check coolant level by opening level valve (fig. 3). If liquid flows out, system contains adequate solution. If coolant is low add water as necessary. NOTE: Refer to "Filling Cooling System" previously, for filling instructions.

2. Check hose connections and tighten clamps as necessary. Cracked, swollen or deteriorated hoses must be replaced.

3. Check radiator core and heater cores for leaks and for accumulation of dirt which obstructs air passage. Clean cores with air hose using low pressure. Repair all cooling system leaks when discovered. Refer to current Diesel Engine Maintenance Manual for procedure to remove and overhaul water pump.

4. Inspect radiator mountings and tighten mounting bolts when necessary.

5. Check operation of radiator shutters which must close completely when power unit operates and must open fully when thermostat exhausts air from power unit.

6. Check operating temperature as indicated by gauge at driver's instrument panel when engine is completely warmed up. Efficient operating temperature range is 160°-180°F. Determine cause of overheating or overcooling and make necessary corrections before operating vehicle.

7. Inspect air recirculation baffles at each side of radiator assembly. Improper cooling may be caused by missing or damaged baffles.

8. With engine control switch in "RUN" position make contact from terminal on overheat thermostat to thermostat body to determine if wiring and signal system is functioning. When contact is made tell-tale light should burn and alarm buzzer should sound.

NOTE: Other tests and adjustments at engine overheat thermostat are covered later in section under "ENGINE OVERHEAT THERMOSTAT," later in this section.

CORROSION DAMAGE PREVENTION

Water without an inhibitor not only causes corrosion in cooling system, which interferes with circulation and cooling, but also corrosion damage to aluminum parts, such as upper and lower radiator tanks, radiator inlet and outlet fittings, engine water outlet manifold, and possibly other parts. Some natural waters are highly corrosive to aluminum; HENCE, PREVENTIVE MEANS ARE NECESSARY, particularly in the presence of ferrous metals (iron and steel).

Use of "deionized" or "soft" water (such as obtained from commercial or domestic water softener) is recommended whenever possible.

Treatment of cooling system for prevention of scale and rust formation has become an accepted automotive maintenance practice. This process consists of introducing into cooling system certain substances called "Inhibitors," which reduce or prevent corrosion of metals and deposition of scale, thus tending to maintain high cooling efficiency.

In general, inhibitors are not cleaners and will not remove scale and rust already formed. INHIBITORS SHOULD BE USED CONTINUOUSLY, preferably immediately after system has been thoroughly cleaned, or when vehicle is new.

However, use of additional corrosion preven-

tives or inhibitors is not recommended with "GM" or other anti-freeze preparations already containing an inhibitor, as an excessive amount may be harmful to rubber parts.

SOLUBLE OIL

Use only in plain water and in anti-freeze solutions which do not already contain an inhibitor. Use in accordance with instructions issued by the soluble oil manufacturers; supply stations have available various soluble oil inhibitors. These are marketed under different names, but their characteristics are similar.

When using soluble oil in plain water, do not add too much. Soluble oil is not lost by evaporation and EXCESSIVE AMOUNTS ARE UNDESIRABLE. The amount of soluble oil in a cooling system should never exceed 1% of the volume of the system. (See Anti-freeze Chart at end of section for cooling system capacity.)

WATER FILTER

Some coaches are equipped with a water filter and conditioner. The filter has a renewable element and corrosion resistor plates which are shown in figure 4.

To maintain efficiency of water filter, element should be changed at about 2,500-3,000 miles of operation on new engines and thereafter every 7500 miles or 500 hours of operation. Instructions below should be followed to replace filter element. Key numbers in text refer to figure 4.

1. Close shut-off valves in filter lines. Remove plug in bottom of filter and drain out liquid.
2. Disconnect line from filter cover (2) then remove screws (1) and lift off cover (2) and gasket (3).
3. Remove element and plates (4 and 5). Discard element at intervals specified above.
4. Clean inside of housing (8) and also clean spring (6) and spring seat (7).
5. Inspect plates (4) for evidence of pits and erosion. The lower corrosion plate (4) should be cleaned thoroughly and buffed on a wheel or with a wire brush until bright, at each element change. Replace plates if not in good condition.
6. Assemble element, plates, and spring in body, then install cover using new gasket. Connect water line to top of filter and open shut-off valves. Check for leaks.

CAUTION: When water filter is used, do not add cleansing or rust-preventive compounds such as, soluble oil or anti-freeze solution containing soluble oil, to cooling solution.

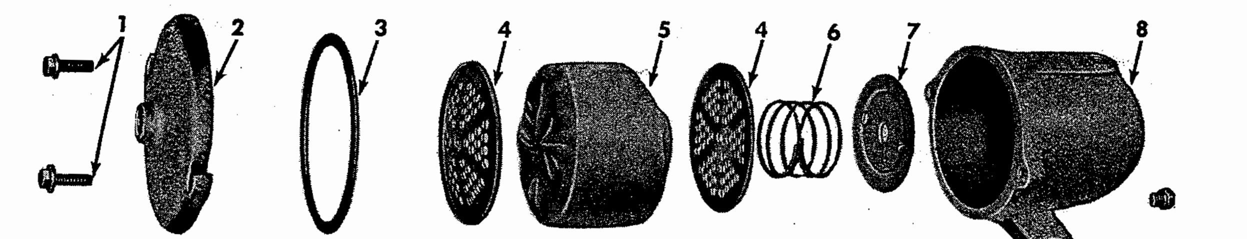
ENGINE THERMOSTAT

When foregoing inspections indicate malfunction of engine thermostats (fig. 2), these units may be removed and their operation checked as directed in following paragraphs.

REMOVAL AND INSPECTION

Key numbers in text refer to figure 2.

1. Drain coolant from system to bring level below water outlet manifold.
2. Close shut-off valve at side of air filter on bulkhead, then disconnect air lines from shutter thermostat (4).
3. Loosen hose clamps and slide hose off thermostat housing (1).
4. Remove thermostat housing attaching bolts, then remove housing, gasket, and thermostat (2).
5. Disconnect air compressor water line from housing (10) at rear of by-pass thermostat (9). Remove bolts attaching upper by-pass tube to housing then remove housing bolts and remove housing (10), gasket, and by-pass thermostat (9).
6. Examine thermostats and note condition. By-pass thermostat (9) should be fully open at room temperature and thermostat (2) should be closed completely at room temperature. Opening and closing temperatures for thermostats are listed in "Specifications" at end of this section. Thermostat operation may be tested in hot water, using



1 Cover Screws
2 Cover
3 Cover Gasket
4 Corrosion-resistor Plates
5 Element
6 Spring
7 Spring Seat
8 Filter Housing

TP-9242

Figure 4—Water Filter and Conditioner Components

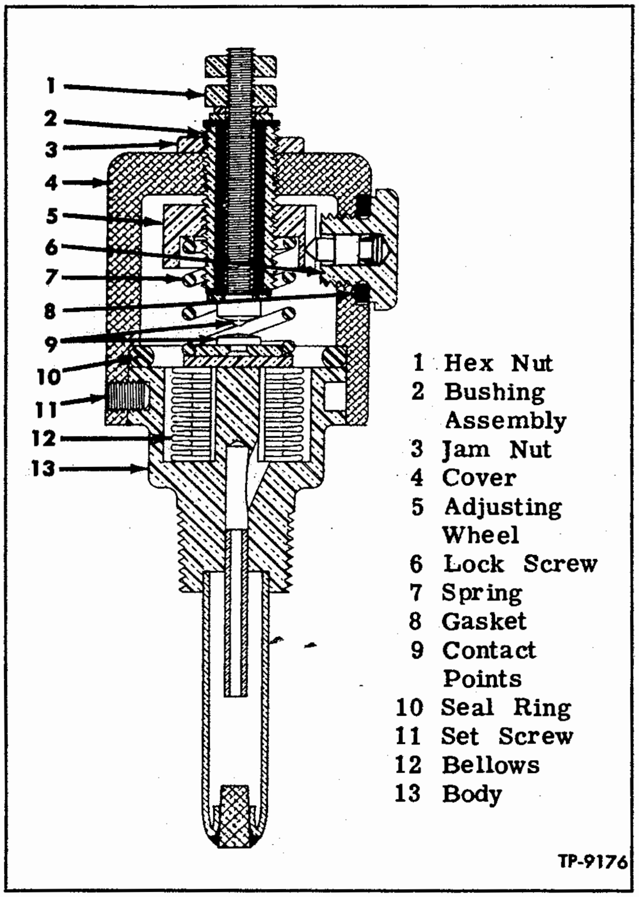


Figure 5—Water Overheat Thermostat

a reliable thermometer to check temperatures at which thermostats open and close. When testing thermostats they must be completely submerged and water should be agitated constantly. Discard thermostat if not operating properly, since thermostats are not adjustable.

THERMOSTAT INSTALLATION

Key numbers in text refer to figure 2.

1. Locate by-pass thermostat (9) and gasket in water outlet housing with spring forward as shown in figure 2, then position housing (10) and install housing bolts.
2. Use new by-pass tube gasket and bolt by-pass tube to housing (10). Connect compressor water line to housing.
3. Insert thermostat (2) into housing with spring and power unit toward rear as shown. Use new gasket and install housing (1).
4. Connect air lines to shutter thermostat (4). Move hose into position at thermostat housing and tighten hose clamps. Open shut-off valve at side of air filter.
5. Fill cooling system, referring to instructions under "Filling Cooling System" previously covered in this section.

TEMPERATURE GAUGE AND SENDING UNIT

Water temperature indicator system consists of two electrically connected units; a sending unit mounted in engine water outlet (fig. 2) and a registering gauge mounted on instrument panel in front of driver.

System is interconnected with control switch as shown on Alarm and Signal Wiring Diagram, at end of this manual. Note that system is operative only with engine control switch in "RUN" position.

TESTS

To test sending unit, disconnect wire from terminal and proceed as follows:

1. Connect one lead of a 1.5 candlepower, 12-volt test lamp to battery terminal on starter solenoid. Touch other lead to body of engine sending unit. If bulb lights, unit is properly grounded. If bulb does not light, check for presence of sealing compound around threads of unit. Remove compound and repeat test.
2. Remove test lamp lead from body of unit and touch lead to terminal on unit. If bulb lights engine unit is shorted and should be replaced.
3. Remove test lamp and reconnect wire from gauge unit to engine unit terminal.
4. Do not attempt to repair engine unit. When installing new engine unit do not use thread sealing compound on threads as this will increase electrical resistance of unit and cause faulty reading on gauge.
5. After testing sending unit, if gauge at instrument panel fails to function properly, refer to ELECTRICAL SYSTEM (SEC. 7), for instructions for checking wiring and gauge unit.

WATER OVERHEAT THERMOSTAT

Engine overheat thermostat is mounted in water outlet housing as shown in figure 2. One is an element type (fig. 5) while the other is a mercury tube type. Refer to "Alarm and Signal Wiring Diagram," at end of this manual for circuits.

OPERATION

When engine becomes overheated, overheat thermostat completes an electrical circuit to telltale light and alarm buzzer.

When alarm is given, vehicle should be immediately stopped and cause of overheating determined.

MAINTENANCE (Element Type)

At approximately 15,000 mile intervals disassemble and inspect engine overheat thermostat as directed below. Key numbers in text refer to figure 5.

1. Remove thermostat assembly from engine.
2. Remove lockscrew assembly (6) and gasket from cover (4). Remove set screws (11) and remove body assembly (13) from cover.
3. Carefully clean and inspect all parts. If points are tarnished or oxidized, polish with dry cloth. DO NOT USE A FILE OR ABRASIVES ON POINTS. Examine bellows for leaks. CAUTION: Further disassembly is not recommended unless suitable means for adjusting point gap when assembling are available.
4. Position seal (10) in cover. Set spring (7) in position and assemble body to cover and lock together with set screws (11). Tighten set screws firmly, but do not force.

TEST AND ADJUSTMENT (Element Type)

Provision must be available to heat the unit in the same cooling solution as being used, and the unit must be connected in series with a 12-volt battery and test light. Before testing, preheat the complete unit to approximate operating temperature (170°F).

Insert thermostat thermal tube and lower half of body threads in cooling solution heated to a temperature 15°F. to 20°F. higher than the thermostat setting of 212°F. Agitate the solution thoroughly and quietly tap the unit. If points close readily, as indicated by the test light, unit is operating properly. If points do not close within the prescribed temperature range, adjustment is required.

To adjust setting, remove lock screw (6) from cover, then turn adjusting wheel (5) through lock screw hole in cover. Make sure jam nut (3) is tight to prevent bushing assembly (2) turning. To increase setting, turn adjusting wheel down to increase spring tension. To decrease setting, turn adjusting wheel up to decrease tension on spring. Leave wheel positioned so that point of lock screw will engage groove in adjusting wheel. Install and tighten lock screw.

INSTALLATION

When installing thermostat in water manifold, do not apply thread compound to first 3 or 4 threads to insure a good ground for the electrical circuit. Tighten unit firmly, then connect wire to terminal, and tighten firmly.

TEST (Mercury Tube Type)

Test of mercury tube thermostat can only be performed when equipment is available for immersing the unit in cooling solution and which can be temperature controlled. Use an ohmmeter when testing. DO NOT USE A TEST LIGHT AS MERCURY COLUMN WILL BE DAMAGED.

Connect an ohmmeter across the two terminal and immerse the tube in cooling solution heated to 212°F. and observe the ohmmeter which should be zero. Allow the temperature of the cooling solution to drop to 207°F. and again observe ohmmeter which should read infinite.

FAN

REMOVAL

Fan assembly is installed on flanged hub assembly at front end of engine crankshaft (fig. 6). Hub assembly is retained by a bolt which is locked by retainer. Fan blades can be removed without removing radiator if sections of fan shroud are first removed to provide clearance.To remove fan hub, the radiator must be removed first to provide space for hub to be pulled off crankshaft.

1. Remove radiator. Refer to "Radiator and Shutter Removal" later covered in this section.
2. Remove bolts attaching fan blade assembly to hub then remove fan blades.
3. Remove snap ring and retainer, then remove hub bolt and spacer.
4. Use special puller (80-0041) to remove hub from crankshaft.

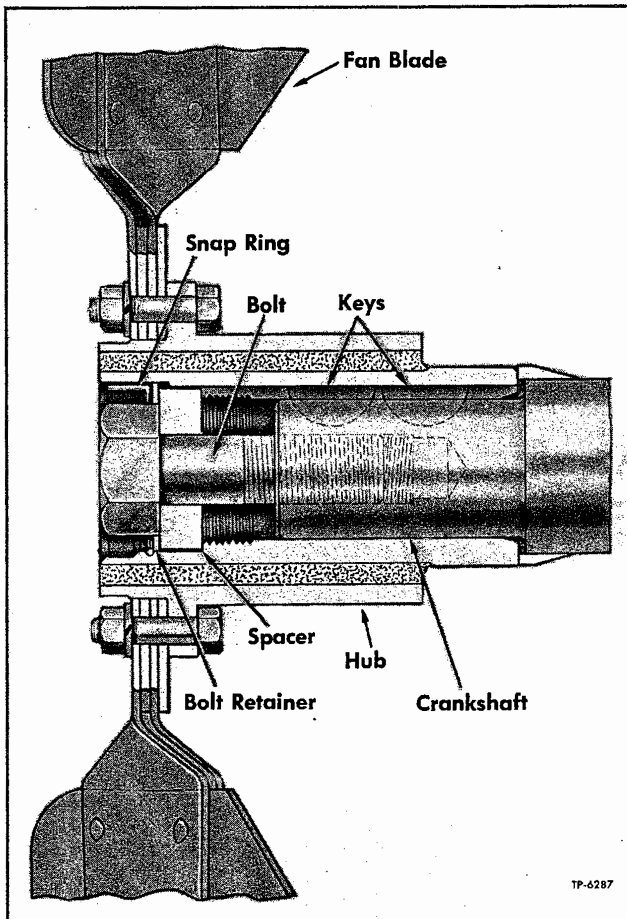


Figure 6—Fan Installed at Crankshaft

INSTALLATION

1. Install hub assembly on engine crankshaft and retain with bolt and spacer. Tighten bolt to 180 to 200 foot-pounds torque.

2. Install bolt retainer and snap ring.

3. Install fan blade assembly and tighten bolts firmly using new lock washers.

4. Install radiator assembly, referring to "Radiator and Shutter Installation" covered later in this section.

Radiator, Shutters, and Thermostat

Radiator, shutters, and baffles to prevent recirculation of air, comprise an assembly which is mounted on a support at left side of engine compartment. Top of the assembly is held in position by bolt and rubber spacers. Power unit which operates shutters is mounted on top of radiator assembly. Surge tank installed above radiator provides space for expansion of coolant without loss. Cooling system is filled through filler cap at surge tank. Pressure valve (fig. 1) incorporates two valves -- one to relieve excessive pressure and one to admit atmosphere as coolant contracts after engine is stopped.

SHUTTER MAINTENANCE

Maintain radiator shutter unit in free working condition by cleaning vane bearings thoroughly with brush or spray gun, or both. Use gasoline or penetrating oil until all dirt is removed. After shutter is once worn in, lubricating oil may be omitted after cleaning.

Frictional wear is very slight, and excessive lubricant may increase rapid collection of dirt. This attention is recommended every 2000 or 5000 miles, depending upon the nature of operation and the tendency toward dirt collection.

AIR FILTER

Air filter, shown in figure 7, prevents moisture from entering shutter thermostat. As air from air tank enters filter, it strikes against baffle which diverts moisture in air stream to bottom of housing. Air then passes through filtering element. Air is again filtered through felt before entering thermostat air valves. Periodic check should be made for leakage at filter connections. Tighten if necessary.

CAUTION: Valve at filter inlet line must be closed before removing plugs or disconnecting outlet line.

Add fluid to filter through filler plug. Refer to Lubrication Chart in LUBRICATION (SEC. 13), for intervals, quantity, and type of fluid. Larger quantities or more frequent filling may overload system.

Air filter should be drained at regular intervals by opening pet cock at bottom. This operation should be performed with pressure in air lines.

Every 10,000 miles, air filter should be disassembled and the felt cleaned with cleaning solvent or replaced.

RADIATOR SHUTTER THERMOSTAT

Radiator shutter thermostat (fig. 8), mounted in housing between engine head and radiator, functions automatically to open and close air line to power unit, which operates radiator shutter.

CLEANING

Key numbers in text refer to figure 8.

1. Remove end cap (9) and needle valve seat cap (1). Wash needle (2) thoroughly in a cleaning solution.

IMPORTANT: Do not use abrasive or metal tools to remove deposits from needle or seats.

A pointed wooden stick provides a practical method of cleaning tapered seats. All parts must be thoroughly cleaned before reassembling. Felts must be renewed, or thoroughly washed in solvent.

2. Apply a drop or two of engine oil on needle (2) then insert needle (2), blunt end toward push pin (5) and into unit. Install seat cap (1) (without spacing gasket (7)) and tighten firmly against needle. Repeat operation a few times, until new seat has been formed.

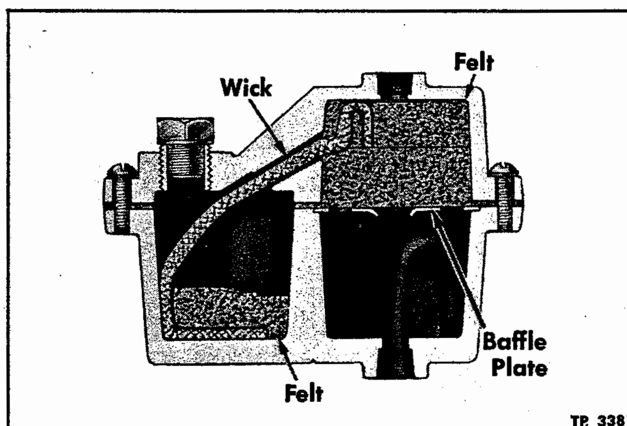
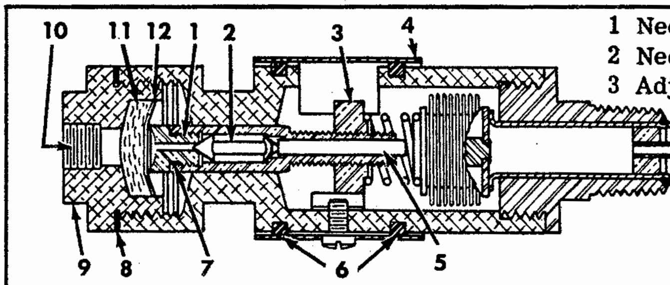


Figure 7—Shutter Air Filter



1 Needle Seat Cap
2 Needle
3 Adjustment Wheel
4 Jacket
5 Push Pin
6 Seal Ring
7 Gasket
8 Cap Gasket
9 End Cap
10 Inlet
11 Felt
12 Screen

TPM-4327

Figure 8—Radiator Shutter Thermostat

3. Remove seat cap (1) and needle (2) and clean. Reinstall needle and seat cap, using new gasket (7) under seat cap.

4. Install screen (12), felt (11), end cap gasket (8), and end cap (9). Tighten end cap firmly.

TESTING

Shutter thermostat should be tested for proper operation, before installation in vehicle. Test in water bath, as follows:

Connect air line to inlet port and an air pressure gauge to outlet port. Suspend thermostat in water, up to mounting threads. Use an accurate thermometer, but make sure neither thermostat nor thermometer contacts bottom of container.

Raise water temperature gradually to closing temperature of thermostat, keeping water thoroughly agitated. Hold water temperature constant for two or three minutes, since thermostat operation may lag on initial cycle.

Note thermometer reading at which gauge shows pressure drop - this indicates closing of thermostat.

If thermostat fails to close at temperatures listed in "Specifications," adjust to proper operating point.

Adjust by turning adjustment wheel (3). Turning wheel one full turn against will change operating range approximately 10^{O}F.

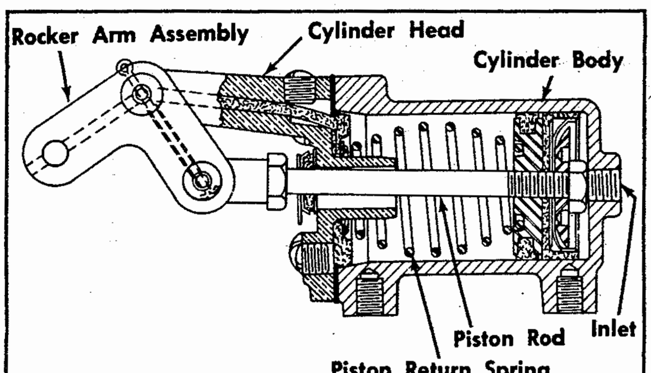


Figure 9—Radiator Shutter Air Cylinder

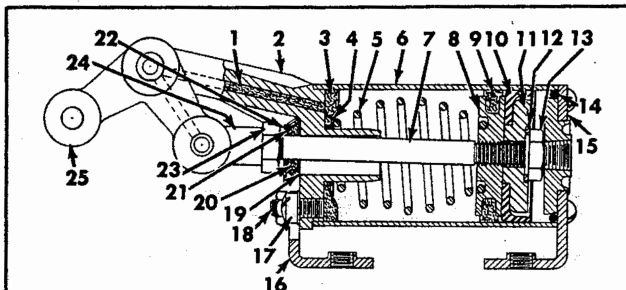
SHUTTER POWER UNITS

AIR CYLINDER TYPE UNIT

An air cylinder is used as regular equipment to operate radiator shutters. Sectional view of two types used are shown in figures 9 and 10. Shutter thermostat previously described, controls air supply to cylinder. When air is admitted at inlet, the piston moves to opposite end of cylinder and piston rod is pushed outward, causing rocker arm to pull on rod attached to shutter vanes. Rod clevis should be adjusted so that shutters are closed completely while air is applied to piston. Shutters must move to fully open position when air supply is cut off. Cylinder should operate with minimum pressure of 35 psi.

Maintenance

Cylinder should be removed and disassembled for cleaning and inspection at intervals of 20,000 miles. Lubricate when reassembling.



1 Oil Wicks
2 Cylinder Head
3 Lubricating Felt
4 Retainer Ring
5 Return Spring
6 Cylinder
7 Piston Rod
8 Piston
9 Piston Felt
10 Piston Cup
11 Piston Follower
12 Lock Washer
13 Nut
14 Seal Ring
15 Cylinder Head and Bracket
16 Mounting Bracket
17 Screw
18 Bolt and Nut
19 Washer
20 Felt
21 Dust Cap
22 Retainer
23 Lock Nut
24 Connector
25 Bellcrank Lever

TPM-5389

Figure 10—Radiator Shutter Air Cylinder

After reassembling, start engine and warm to normal operating temperature. Check shutter position, making sure shutters are fully open. Check for air leaks with soapy water.

DIAPHRAGM TYPE UNIT

As special equipment, some vehicles are equipped with a diaphragm type power unit as shown in figure 11. Diaphragm type unit is similar to air brake chamber, consisting essentially of a pressure plate, diaphragm, push rod, non-pressure plate, and spring. Assembly is mounted on bracket at top of radiator assembly. Air supply is controlled by shutter thermostat in same manner as for cylinder type unit previously described under "Air Cylinder Type Unit." As air pressure enters chamber behind diaphragm, the diaphragm forces push rod outward, thereby applying force to bell crank which in turn pulls upward on shutter rod which operates shutter vanes. Diaphragm stop limits movement of push rod assembly. When air supply is cut off by thermostat, spring moves push rod and air is exhausted from chamber behind diaphragm.

Maintenance

The only maintenance normally required is periodic inspection of diaphragm unit for air leakage, and lubrication of clevis pins in linkage.

Test for air leaks as follows:

1. With air pressure applied, coat with soap suds the bolting flanges holding diaphragm. No leakage is permissible. In case leaks exist, tighten flange bolts. Bolts must be tightened evenly and only sufficiently to prevent leakage.

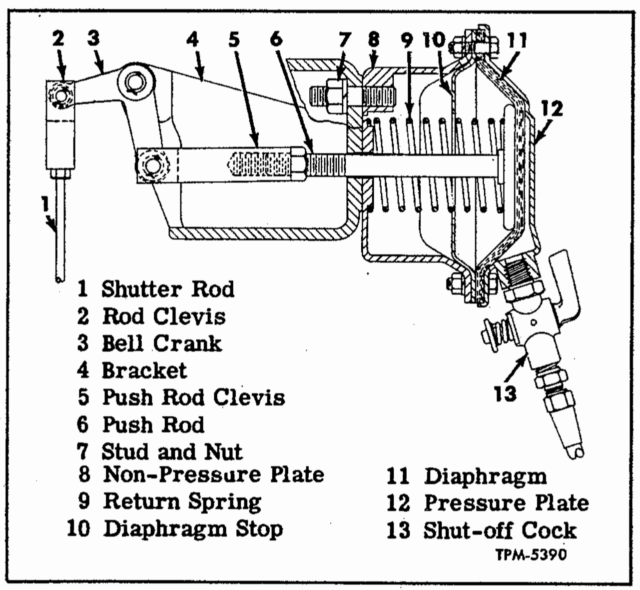


Figure 11—Diaphragm Type Shutter Power Cylinder

2. With air pressure applied to diaphragm unit, check leakage through diaphragm by tapping all openings, then applying soap suds around push rod at bracket. If there is any evidence of air leakage, replace the diaphragm.

RADIATOR AND SHUTTER REPLACEMENT

REMOVAL

1. Close valves in heater lines and drain cooling system as previously described in this section under heading "Draining Cooling System."
2. Remove four screws holding radiator grille door, then remove door and left bumper extension assembly.
3. Shut off air supply to shutter thermostat by closing valve at side of air filter. Disconnect air line from shutter power unit at top of radiator. Detach clips holding overflow pipe.
4. Remove inlet and outlet castings from radiator top and bottom tanks.
5. Disconnect lines at heater booster pump at top of radiator.
6. Remove bolt and insulators which attach top of radiator assembly to support bracket.
7. Place support under radiator assembly. Remove bolts at each end of radiator support channel, then carefully tilt radiator assembly and remove from vehicle.
8. Fan shroud, support channel, and shutter mechanism, as well as top and bottom tanks can be disassembled as necessary to make repairs or replacements.

INSTALLATION

1. Assemble shutter mechanism and fan shroud to radiator assembly, and install support channel at bottom of the assembly.
2. Move the radiator assembly into position in vehicle then install mounting bolts at each end of support channel.
3. Install support bolt and rubber insulators at top of radiator. Clip overflow pipe in place, and connect air line to shutter power unit.
4. Bolt inlet and outlet casting to radiator assembly using new gaskets.
5. Connect water lines at heater booster pump at top of radiator.
6. Install bumper extension and radiator grille door assembly.
7. Open heater line valves and open air valve at shutter air filter.
8. Fill cooling system as previously directed in this section under heading "Filling Cooling System."
9. Start engine and inspect all units and connections for leaks. Recheck coolant level after running engine.

SPECIFICATIONS

COOLING SYSTEM CAPACITY

Engine, Radiator, Pipes & Fittings	56 qt.
Heating System	18 qt.
Total	74 qt.

ANTI-FREEZE CHART

Lowest Expected Temp. (Fahr.)	Qts. of Permanent Type Anti-Freeze Req'd.
+10°	18-1/2
0°	25
-10°	30
-20°	32
-30°	37

NOTE: Only a permanent-type antifreeze, such as ethylene glycol, is recommended for use on vehicles equipped with radiator shutters.

THERMOSTAT - WATER CIRCULATION

Starts to Open	173°F.
Fully Opened	186°F.

THERMOSTAT - WATER BY-PASS

Type	Reverse-Acting
Starts to Close	170°F.
Fully Closed	183°F.

OVERHEAT THERMOSTAT SWITCH (ALARMSTAT)

Make	Kysor
Vendor No.	C-4740-212
Point Gap	0.050"
Points Set to Close at	212°F.

TEMPERATURE GAUGE

Make	AC Spark Plug Div.
Type	G
Operating Range	100°F.-220°F.
Voltage	6

SURGE TANK PRESSURE VALVE

Valve Opens at (Pressure in Lbs. per Sq. In.)	3-1/2 - 4-1/2

RADIATOR

Type	Fin & Tube
Frontal Area	735 Sq. In.
Thickness	3-3/4 In.

RADIATOR SHUTTER THERMOSTAT

Make	Kysor
Model	C-5500-80
Valve Closes	180°F.

FAN

Drive	Crankshaft
Number of Blades	6
Diameter	26"
Direction of Rotation	Counterclockwise

IMPORTANT: Only permanent type anti-freeze is recommended for use in engine cooling system.

Refer to DIESEL ENGINE MAINTENANCE MANUAL for water pump repair instructions.

Electrical System

This group, covering complete maintenance and repair information on Electrical Systems, is divided into seven sections as shown in Index below:

Wiring and Miscellaneous Electrical

WIRING DIAGRAMS

The electrical system is divided into several separate systems, each system being classified according to its function or purpose. A separate wiring diagram is provided for each major system, as well as diagrams for special equipment used in conjunction with these systems. In some cases a circuit on one diagram ties-in with circuits shown on other diagrams, and cross-references are made to other diagrams. Wiring Diagrams are folded and inserted in a pocket inside the back cover of this manual. Following is a list of the diagrams and a brief outline of units shown on each diagram.

Lighting System Wiring Diagram - MD-75571

This diagram shows all standard interior and exterior lights and their controlling switches, relays, and circuit breakers except directional, stop, and tell-tale lights which are shown on "Alarm and Signal Wiring Diagram."

Alarm and Signal Wiring Diagram - MD-79109

This diagram shows all switches, relays, buzzer and rectifier, tell-tale lights, gauges, sending units, circuit breakers, and wiring circuits necessary for the operation and control of all audible and visual alarm and signal devices, except hand brake alarm system.

Engine Control and Generator Wiring Diagrams

Standard - MD-75606

Special - With Automatic Engine Shut-off and Stop Overrule - MD-82893

Special For Greyhound Coaches - MD-83830

These diagrams show generator, regulator, master circuit breaker, master relay, and battery circuit; starter and all solenoids, relays, and switches necessary to start and stop the engine; transmission reverse solenoid, relay, and switch.

Heating and Ventilation Wiring Diagrams

Standard - MD-77489. This diagram shows heating and cooling blower motor, defroster motors, fans, relays, switches, and circuit breakers used on coaches equipped with standard GM Heating and Air Conditioning System.

Special - Without Air Conditioning - MD-75683. This diagram shows heating and ventilating blower motor, defroster motor, fans, relay, switches, and circuit breakers used on a standard vehicle from which the air conditioning system has been omitted, and the space normally occupied by the air conditioning unit converted into a baggage compartment.

Special For Greyhound Coaches - MD-84005. This diagram shows heating and cooling blower motors, defroster motors, fans, thermostat, relays, switches, and circuit breakers used on Greyhound coaches.

Lavatory Wiring Diagrams - MD-83294 and MD-84004

These diagrams show relays, ventilator and water pump motors and controls, lights, and emergency buzzer and switch used in conjunction with the lavatory. MD-83294 shows system with circuits fed hot and actuated by the door lock switch as used on Greyhound coaches. On other coaches, circuits are controlled by the Diesel control switch as shown on MD-84004.

Step Light Wiring Diagram - Special - MD-76189

This diagram shows special step light circuit on vehicles having the step light circuit controlled

by the passenger signal control switch instead of by the marker light switch as shown on the standard lighting system wiring diagram (MD-75571).

Seat-Mounted Aisle Light Wiring Diagram - Special - MD-75423

This diagram shows lights and switch used on some coaches having eight or nine seat-mounted aisle lights.

Hand Brake Alarm Wiring Diagrams - MD-84025 and MD-84276

These diagrams show hand brake alarm buzzer and tell-tale circuits. MD-84025 shows the circuits on vehicles having the alarm system operating circuit controlled by the transmission shift lever stop overrule switch. MD-84276 shows circuits on vehicles having the operating circuit controlled by the generator.

INDEX OF ELECTRICAL UNITS

Certain electrical units, when closely associated with some other system or unit, are covered in other sections of this manual. Index following lists all major electrical units, together with manual section in which they are covered and page number on which the section begins.

TESTING CIRCUITS

A careful study of the wiring diagrams should be made to determine the source and flow of current through each electrical circuit. When a circuit is thoroughly understood, a point to point check can be made with the aid of the applicable wiring diagram, to determine the location of trouble. Any circuit can be tested for continuity or shorts with a test light or low-reading voltmeter.

All electrical connections must be kept clean and tight. Loose or corroded connections will cause discharged battery, difficult starting, dim lights, and improper functioning of other electrical circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol plugs are securely tightened. Refer to other sections previously listed for information on major electrical units and systems.

WIRE SIZES AND COLORS

Each wire in the electrical system is of a specific size as designated on the Wiring Diagrams. When replacing wires, the correct size as indicated must be used. Never replace a wire with one of a smaller size.

The insulation on each wire is distinctly colored and patterned to assist in tracing and testing circuits, and to assist in making connections.

Abbreviations and symbols are used in wire insulation color and pattern designations on Wiring Diagrams and in the tabulations which follow. Abbreviations and symbols are as follows:

*Blk.	Black	Grn.	Green
Blu.	Blue	Nat.	Natural
Brn.	Brown	Tr.	Tracer
Ch.	Check	Yell.	Yellow
Cr.	Cross	//	Parallel

*All wires leading from the electrical compartment junction panel into the engine compartment are covered with black heat-resistant insulation. To assist in making proper connections, a tag near end of each wire bears the number or abbreviation of the terminal to which it connects.

GAUGE PANELS

Two gauge panels (instrument clusters) are mounted directly in front of driver, one on either side of steering column (fig. 1). All gauges except "Air Pressure" are electrically operated. Panel at left of steering column contains Speedometer, Oil Pressure Gauge, and Engine Temperature Gauge. Panel at right of steering column contains Air Pressure Gauge and Generator Charge Indicator. Space is also provided in right side panel for installation at a special Electric Fuel Gauge. Rear view of gauge panels is also shown in figure 1.

Wiring harness connections to rear side of panels are made through multiple plug and receptacle type connectors. All wires leading from receptacles to gauges have the same color insulation. However, a tag near end of each wire bears a letter corresponding to the lettered terminal to which it connects in the receptacle.

Individual gauges can be replaced by disconnecting wires from terminals on gauge and removing clamps securing gauge to back of panel. When installing oil pressure or temperature gauge in left panel, resistor assembly must be installed on terminal marked "IGN," and the "B" wire must be connected to the resistor terminal. "D" wire connects to the "SENDER" terminal on the temperature gauge, and "C" wire connects to the "SENDER" terminal on the pressure gauge.

Snap-in type instrument light sockets are a part of the receptacle and harness assembly. Light bulbs are accessible by pulling socket out of holder on back of panel. Each receptacle is provided with a key in housing which meshes with a slot in plug to assure correct installation. Do not force plug into receptacle. If properly aligned, plug will enter receptacle under light pressure.

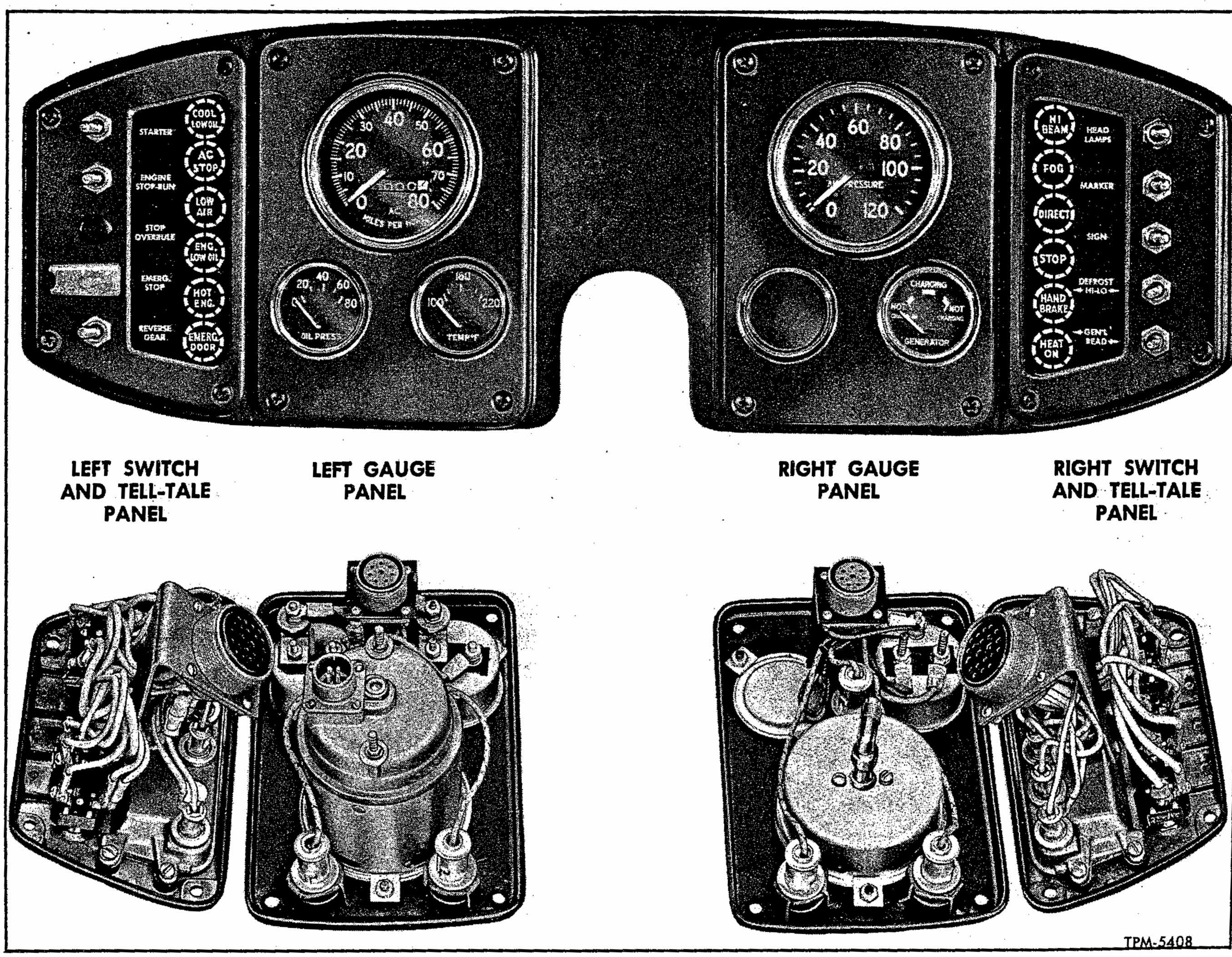


Figure 1—Gauge and Switch Panels

SWITCH AND TELL-TALE PANELS

Two switch and tell-tale panels are mounted in front of driver, one at each side of gauge panels (fig. 1). Switches are identified by names printed on plastic panel at side of switches. "STARTER," "EMERG. STOP," and "REVERSE GEAR" switches in left switch panel are single-pole, single-throw, momentary on switches; these switches must be held in closed-circuit position and will return to open-circuit position when released. ("STARTER" switch on Greyhound coaches is a double-throw switch.) "ENGINE STOP-RUN" switch in left switch panel is a double-pole, single-throw switch with no center off position. "HEAD LAMPS," "MARKER," and "SIGN" switches in right switch panel are single-pole, single-throw on-off switches. "DEFROST" and "GEN'L-READ" switches in right switch panel are single-pole, double-throw switches with center off position. Circuits controlled by each light switch are described in "LIGHTING SYSTEM" section later in this group.

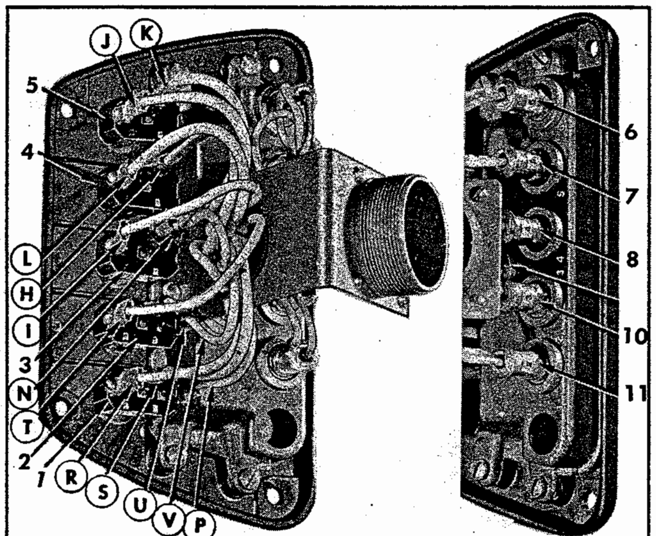
Tell-tale lights are installed under plastic panel at side of switches. Tell-tale identification, shown in dotted lettering in figure 1, is visible only when the light bulb under the lettering is illuminated. Refer to "Tell-tale Alarm System" later in this section for operation of tell-tales.

NOTE: On vehicles equipped with V.C.H. Heating and McGraw Air Conditioning, "HEAT ON" tell-tale is installed in open socket (No. 1) shown in figure 2, "A.C. STOP" tell-tale is used in open socket (No. 2) shown in figure 3, and air conditioning low oil tell-tale (No. 1) is not used.

Details of units and wiring connections at back side of panels are shown in figures 2 and 3. All light sockets are snap-in type, and bulbs are accessible by pulling sockets out of holder. Sockets are a part of the receptacle and harness assembly. Each socket is numbered as shown in figures 2 and 3, and must be installed in opening bearing the same number.

Each switch is retained in panel by two nuts, one on each side of panel. When replacing a switch make sure replacement switch is the same type as the one removed.

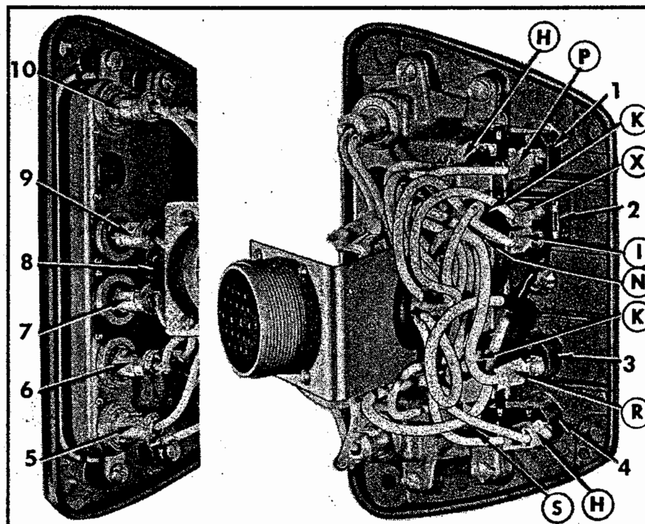
All wires leading from the receptacle to switches have the same color insulation. However, the insulation on each wire is imprinted with a letter corresponding to the lettered terminal to which it connects in the receptacle. Circled letters on figures 2 and 3 indicate the letter printed on the insulation, thereby identifying each wire connected to each terminal on all switches.



1 Reading - General Light Switch
2 Defroster Switch
3 Sign Light Switch
4 Marker Light Switch
5 Headlight Switch
6 Hi-Beam Tell-tale - No. 6
7 Fog Light Tell-tale - No. 5
8 Directional Signal Tell-tale - No. 4
9 Switch Name Plate Light
10 Stop Light Tell-tale - No. 3
11 Hand Brake Tell-tale - No. 2

TP-9103

Figure 2—Right Side Switch and Tell-Tale Panel



1 Starter Switch
2 Engine Stop-Run Switch
3 Emergency Stop Switch
4 Reverse Gear Switch
5 Emergency Door Tell-tale - No. 6
6 Hot Engine Tell-tale - No. 5
7 Engine Low Oil Tell-tale - No. 4
8 Switch Name Plate Light
9 Low Air Tell-tale - No. 3
10 Air Cond. Engine Low Oil Tell-tale - No. 1

TP-9104

Figure 3—Left Side Switch and Tell-Tale Panel

DRIVER'S CONTROL PANEL

Controls mounted on control panel at left of driver and markings on name plate depend upon the type of heating and air conditioning equipment used (fig. 4). Each type is described below:

WITH STANDARD GM AIR CONDITIONING

The following standard equipment switches are mounted on control panel shown in figure 4: Air conditioning engine "CHOKE" switch, air conditioning engine "START" switch, cooling and heating system "MASTER SWITCH," "BUZZER" switch, "DRIVERS FAN" switch, and "DRIVERS LIGHT" switch. The switch marked "BUZZER" actually controls the circuit to the passenger chime signal. Two "DRIVERS FAN" switches are shown on control panel in figure 4; the one next to the "BUZZER" switch is used on some vehicles to control the circuit to a special windshield fan.

WITH V.C.H. HEATING AND McGRAW AIR CONDITIONING

With this system, the following switches are on control panel (fig. 4) at left of driver: Air conditioning engine "START" switch, air conditioning "ENGINE CONTROL" switch, "BLOWER" switch, temperature control rheostat, "CHIME" switch, two "FAN" switches, "DRIVER LIGHT" switch, and "SEAT LIGHT" switch. The switch marked "SEAT LIGHT" controls special seat-mounted aisle lights used on some vehicles.

BOTH TYPES

Access to switch terminals is gained by removing the junction and circuit breaker panel cover at left of drivers seat, then removing six screws, nuts, and lock washers attaching switch plate to housing. When replacing switches, make sure the replacement switch is the same type as the one removed. If wire insulation colors and patterns are not readily apparent, tag each wire as it is removed and note the terminal to which it attaches. When installing switch, position switch with lever down in "OFF" position, and make sure wires are connected to proper terminals.

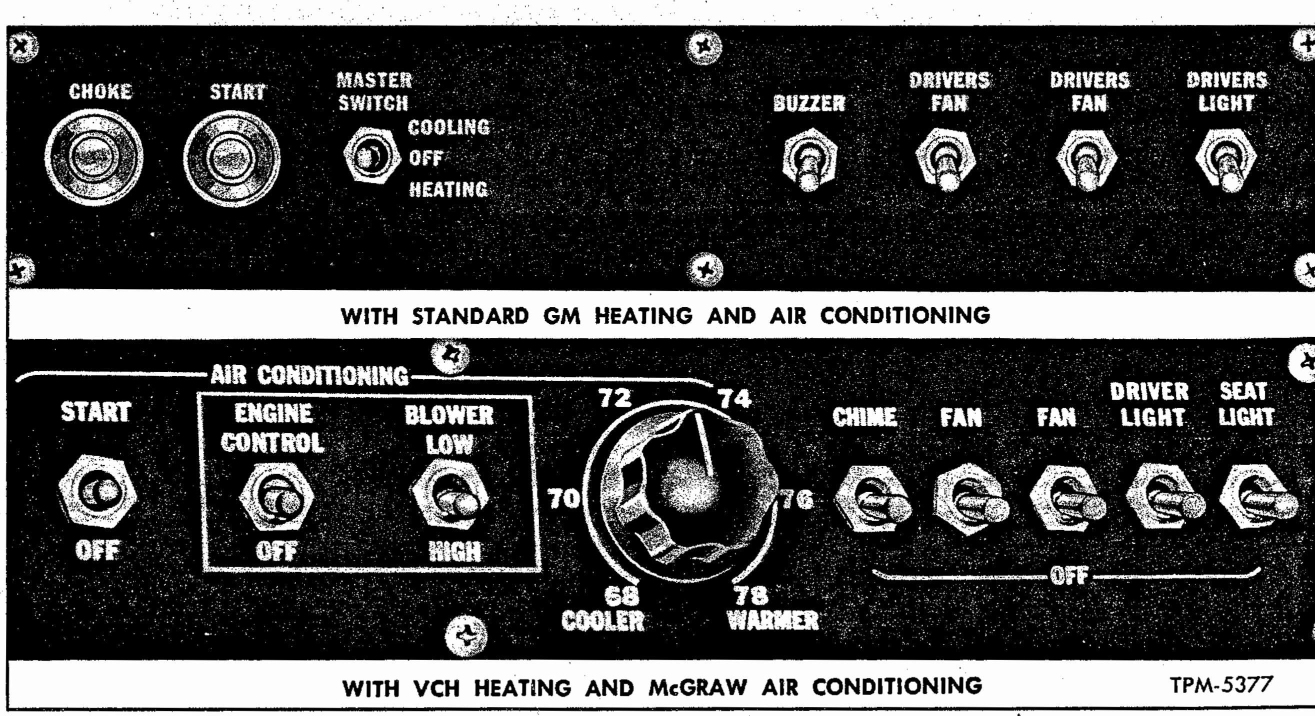


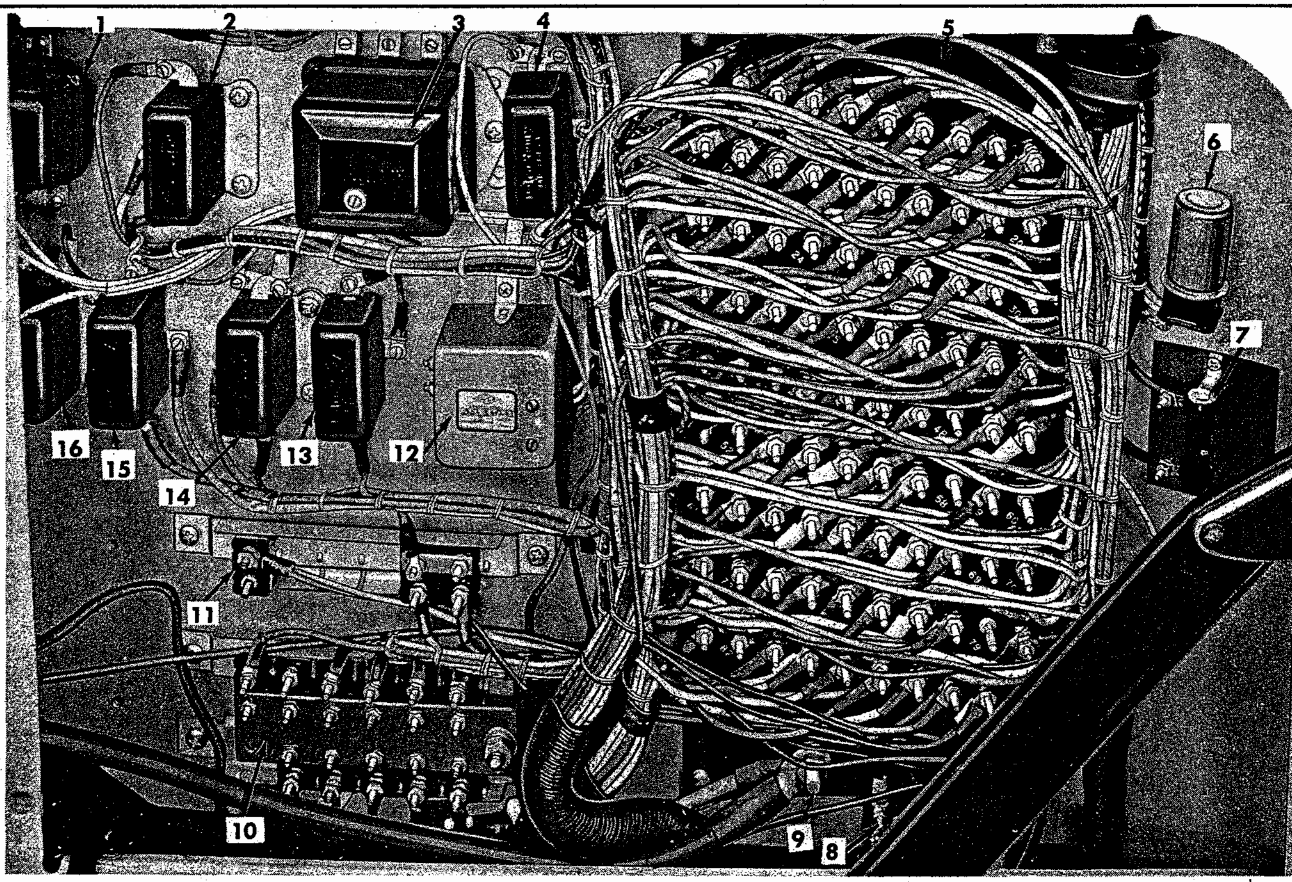
Figure 4—Driver's Control Panels

CONTROL PANEL JUNCTIONS

Junction panel (fig. 5), located below the control panel at left of driver's seat, is accessible after removing the junction and circuit breaker panel cover; driver's air outlet at lower rear corner of cover will be removed with the cover.

Panel contains terminal posts numbered from 1 through 90. Numbers on panel correspond to numbers on Wiring Diagrams and in the tabulation which follows: The tabulation lists each terminal number, the circuit it carries, and the size, color,

and pattern of the wires which connect to the terminal. A similar tabulation is attached to the back of the junction panel cover. Some of the unused terminals marked "open" or "spare" in the tabulation may be used for special electrical equipment.



1 *Hand Brake Buzzer
2 *Blower Control Relay
3 Alarm Signal Buzzer and Rectifier Assembly
4 *Defroster Booster Water Pump Relay
5 Terminal Block (Sec. 7)
6 Directional Signal Flasher
7 Stop Light Resistor
8 *Blower Control Relay Rectifier
9 Battery Junction
10 Circuit Breaker Panel
11 *Junction Block
12 *V.C.H. Heat Control Relay
13 Stop Light Relay
14 Diesel Control Master Relay
15 Horn Relay
16 *Hand Brake Buzzer Relay

* Equipment Not Standard

TPM-5381

Figure 5—Control Panel Junctions, Circuit Breakers, and Other Electrical Equipment

Refer to Symbol ▱ on Wiring Diagrams.

Terminal No.	Circuit	Wire Size & Color
1	Marker Light Switch	No. 14 Nat. - Blk. Tr.
	*Spot Light Switch	Gray
2	Fog Light Tell-tale	No. 16 Grn. - 2 Nat. // Tr.
3	Low Air Pressure Tell-tale	No. 16 Red - Nat. Tr.
4	Directional Tell-tale	No. 16 Nat. - Grn. & Red Cr. Tr.
5	Stop Light Switch	No. 14 Red - 2 Blk. // Tr.
6	*Engine Stop Overrule Sw. (at shift tower)	No. 14 Yellow - 2 Red // Tr.
7	Air Cond. Engine Choke	No. 14 Blk. - Nat. Cr. Tr.
8	Air Cond. Low Oil Tell-tale	No. 16 Nat. - Red Ch.
9	*Fire Deflectors	Green - Nat. Cr. Tr.
10	*Hand Brake Alarm Relay	No. 16 Nat. - Blk. & Red Cr. Tr.
11	Destination Sign Switch	No. 16 Brn. - Blk. Cr. Tr.
12	High Beam Tell-tale	No. 16 Nat. - Grn. Cr. Tr.
13	Low Oil Tell-tale	No. 16 Nat. - Blk. & Grn. Cr. Tr.
14	Directional Switch Feed	No. 16 Yellow - Grn. Tr.
15	Horn	No. 10 Brn. - Blk. & Red Cr. Tr.

*Equipment Not Standard.

Continued on next page.

Terminal No.	Circuit	Wire Size & Color
16	Emergency Stop Switch	No. 14 Nat. - Grn. & Red Cr. Tr.
17	Air Cond. Engine Starter Sw.	No. 14 Grn. - Red Check
18	Speedometer (C Terminal)	No. 16 Grn. - 2 Red // Tr.
19	*Wheel Sanders	Grn. - Red Cr. Tr.
20	*Emerg. Door Sw. (Fed Hot)	Blk. - 2 Blue Tr.
21	Headlight Switch	No. 14 Blk. - 2 Grn. // Tr.
22	Baggage Comp't Lights	No. 16 Brn. - // Red Tr.
23	Hot Engine Tell-tale	No. 16 Yellow
24	Left Front Directional Signal Light	No. 16 Orange - Blk. Tr.
25	Horn Button	No. 16 Brn. - Red Ch.
26	Reverse Switch	No. 16 Nat. - 2 Red // Tr.
27	Air Cond. Test Ignition Switch	No. 14 Brn. - Nat. Tr.
28	Speedometer (B Terminal)	No. 16 Nat. - Blk. & Red // Tr.
29	Open	
30	Open	
31	Driver's Lamp	No. 16 Yellow - Blk. Tr.
32	Destination Sign	No. 16 Brn. - Blk. Cr. Tr.
33	Emerg. Door Tell-tale	No. 16 Blue - Blk. Tr.
34	Left Rear Stop & Direct. Signal Light	No. 16 Nat. - Blk. Cr. Tr.
35	Stop Light Relay	No. 14 Grn. - 2 Blk. // Tr.
36	Diesel Control Switch (Charge Indicator)	No. 16 Grn. - Red Tr.
37	Air Cond. Engine Starter Switch	No. 14 Orange - Red Tr.
38	Speedometer (A Terminal)	No. 16 Brn. - Nat. & Blk. Cr. Tr.
39	*From Seat Light Switch	No. 16 Grn. - Yell. Tr.
	*To Right Side Seat Lights thru No. 40 Elect. Comp't Jct. .	No. 14 Grn. - Brn. Cr. Tr.
	*To Left Side Seat Lights	No. 16 Blk. - Grn. Line
	*To Door Operated Stop Light Sw. (Normally from No. 71) .	No. 16 Nat. - Blk. Tr.
40	Speedometer (D Terminal)	No. 16 Blk. - 2 Brn. // Tr.
41	General Interior Lights	No. 16 Blk. - Red Tr.
42	*Temperature Control Rheostat	No. 16 Blue
43	Open	
44	*Heating Thermostat	No. 16 Blk. - Grn. Ch.
	*Temperature Control Rheostat	No. 16 Orange
	*Heating Control Relay	Black
45	*Water Valve	No. 14 Grn. - 2 Brn. // Tr.
	*Heating Control Relay	Green
46	*Water Pump Switch (thru No. 37 Elect. Compt. Jct.) . . .	No. 16 Green
	*Heating Control Relay	Yellow
47	*Heating Thermostat	No. 16 Brn. - 2 Nat. // Tr.
	*Heating Control Relay	Orange
48	*Electric Tachometer	Brown
49	*Heat-on Tell-tale	No. 16 Natural
	*Heating Control Relay	White
50	*From Passenger Signal Switch	No. 16 Brn. - Blk. Tr.
	*To Door-Operated Step Light Sw (Normally from No. 71) .	No. 16 Nat. - Blk. Tr.
51	Reading and General Light Sw. Feed	No. 16 Blk. - Grn. Tr.
52	Open	
53	Oil Pressure Gauge	No. 16 Nat. - Blk. & Grn. // Tr.
54	Right Rear Stop & Direct. Signal Light	No. 16 Nat. - Red Cr. Tr.
55	*Hand Brake Tell-tale Switch	No. 16 Grn. - Blk. Tr.
	*Hand Brake Alarm Relay	No. 16 Nat. - Red Tr.
56	Diesel Control Switch Feed	No. 12 Red
57	Heating Side of Master Switch	No. 14 Nat. - Grn. & Red // Tr.
58	*Electric Tachometer	Green
59	Spare	No. 16 Nat. - Brn. Tr.
60	Open	
61	Reading Light Switch	No. 16 Blk. - Nat. Tr.
62	*Windshield Fan	No. 16 Red - 2 Blue // Tr.
63	Engine Temperature Gauge	No. 16 Nat. - 2 Blk. // Tr.
64	Right Front Directional Signal Light	No. 16 Orange - Grn. Tr.
65	Stop Light Resistor	No. 16 Blk. - Red Cr. Tr.
66	Diesel Control Master Relay	No. 16 Grn. - Nat. Tr.
67	Defroster Relay	No. 14 Yellow - 2 Blk. // Cr. Tr.
68	*Electric Tachometer	Blue - 2 Nat. // Tr.
69	*Spare Tell-tale	Yellow - Red Tr.
70	*Spare Tell-tale	Blue - Nat. Tr.
71	Door Operated Step Light Switch	No. 16 Nat. - Blk. Tr.
	To No. 2 Elect. Comp't Jct.	No. 14 Nat. - Blk. Tr.

*Equipment Not Standard.

Continued on next page.

Terminal No.	Circuit	Wire Size & Color
72	Door Step Light	No. 16 Yell. - 2 Blue // Tr.
73	From No. 5 Control Panel Circuit Breaker	No. 14 Nat. - 2 Grn. // Tr.
	To Alarm Buzzer & Rectifier	No. 16 Nat. - 2 Grn. // Tr.
	*To Hand Brake Buzzer (if used)	No. 16 Natural
	To Gauges and Tell-tale Lights	No. 14 Nat. - 2 Grn. // Tr.
	To Starter and Reverse Switches	No. 14 Nat. - 2 Grn. // Tr.
74	Stop Light Relay to Direct. Signal Switch	No. 14 Grn. - Nat. Cr. Tr.
75	Stop Light Tell-tale	No. 16 Red - Blk. Tr.
76	Starter Switch	No. 16 Red - Grn. Tr.
77	Defroster Switch (Hi)	No. 14 Yellow - Blue Tr.
78	*Electric Tachometer	Blue
79	Open	
80	Ground	Black
81	Dash Lights & Frt. Marker Lights	No. 14 Nat. - Blk. Tr.
82	Headlight Selector Switch	No. 14 Blk. - 2 Grn. // Tr.
83	Generator Charge Indicator	No. 16 Brn. - Nat. Cr. Tr.
84	Passenger Chime Signal	No. 16 Orange
85	*Electric Fuel Gauge	No. 16 Natural
86	Speedometer Drive Unit	No. 14 Green
	Engine Stop Solenoid	No. 14 Green
	*Lavatory Control Relay	No. 14 Green
87	Defroster Switch Feed	No. 14 Yellow - 2 Blk. // Tr.
88	Driver's Fan	No. 16 Brn. - 2 Red // Tr.
89	Cooling Side of Master Switch	No. 14 Blk. - Brn. Cr. Tr.
	*Blower Control Relay	No. 14 Blk. - Brn. Cr. Tr.
90	Ground	Black

*Equipment Not Standard.

CONTROL PANEL CIRCUIT BREAKERS

Circuit breaker panel, located below the control panel at the left of the driver's seat, is accessible after removing the junction and circuit breaker panel cover (fig. 5). Panel has space for 18 circuit breakers, however, only 14 are used in conjunction with standard electrical equipment. (Illustration in figure 5 shows 13 circuit breakers and 1 junction block on circuit breaker panel. This is for Greyhound coaches only. Refer to figure 6 for standard circuit breaker arrangement.) Circuit breakers are automatic reset type, protecting various circuits as indicated in the tabulation which follows. Any condition which causes an overload on a circuit, such as a short, will cause circuit breaker bimetal element to open the circuit; when element cools, circuit breaker will again close the circuit. This off and on cycle will repeat until the switch controlling the defective circuit is turned off, or until the cause of the overload has been located and corrected. In the event a circuit breaker becomes defective (burns out or sticks closed), the defective circuit breaker must be replaced.

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel. To identify circuit breakers, it is necessary to refer to diagram shown in figure 6, or to diagram attached to back of panel cover. Amperage rating of each circuit breaker is shown in figure 6.

The following tabulation lists each circuit breaker number (as identified in figure 6), amperage rating, the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to the circuit breaker terminal. Unit shown in number 1 position on figure 5 is a junction block used in lavatory emergency buzzer circuit in Greyhound coaches only. Numbers 2, 3, and 13 (fig. 6) are for spare circuit breakers, or may be used for special electrical equipment. Circuit breakers 4, 5, and 6 are connected by a bus bar and are fed from the "SOL" terminal on the master control relay. Circuit breakers 7 through 18 are all connected by a single bus bar which is fed directly from the battery.

Circuit Breaker No.	Size	Circuit	Wire Size & Color
1	-	Spare	
2	-	Spare	
3	-	Spare	
4	20 Amp.	Passenger Signal Switch	No. 16 Orange - Nat. Tr.
5	20 Amp.	Tell-tale Alarm System, and Starter and Reverse Switches	No. 14 Nat. - 2 Grn. // Tr.

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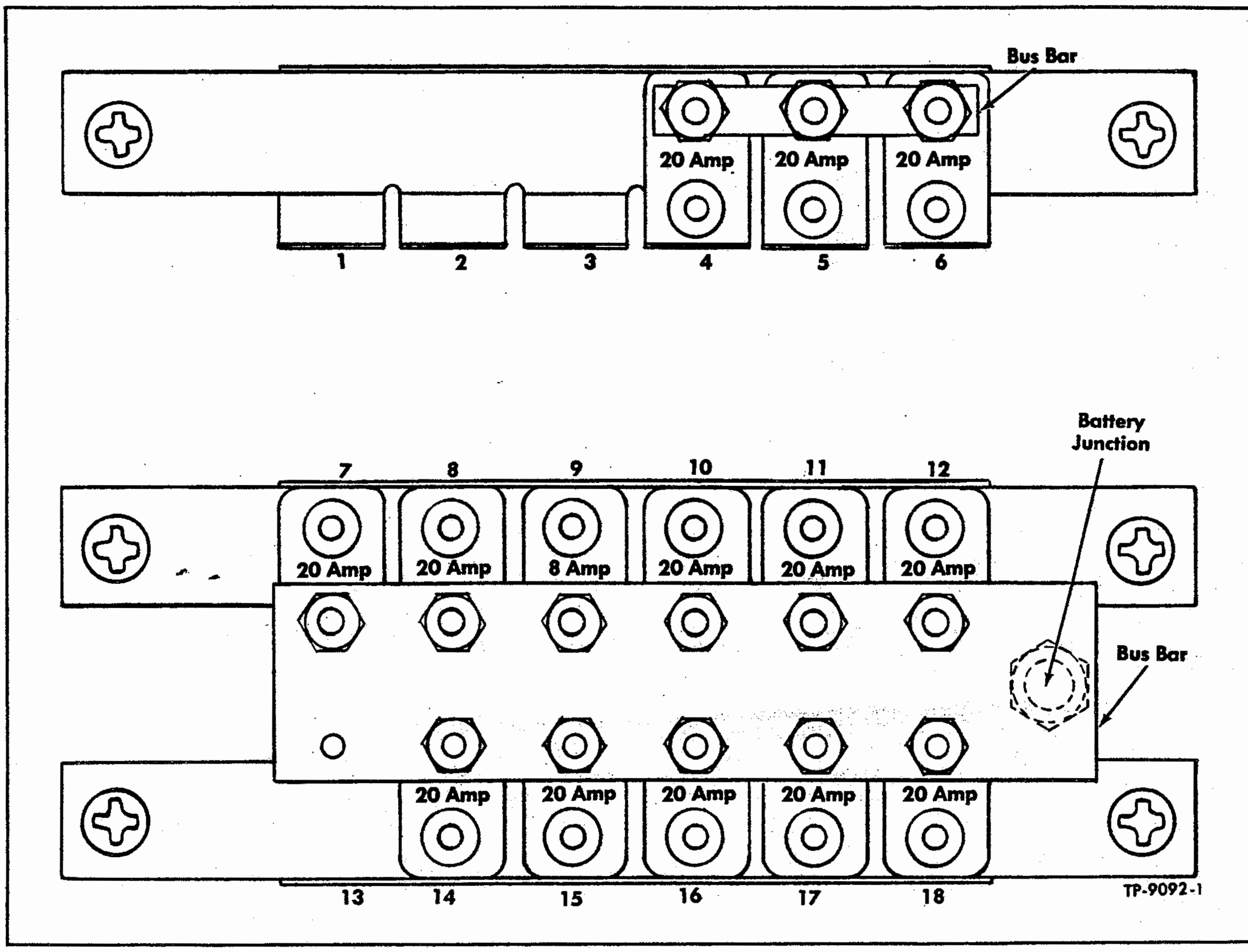
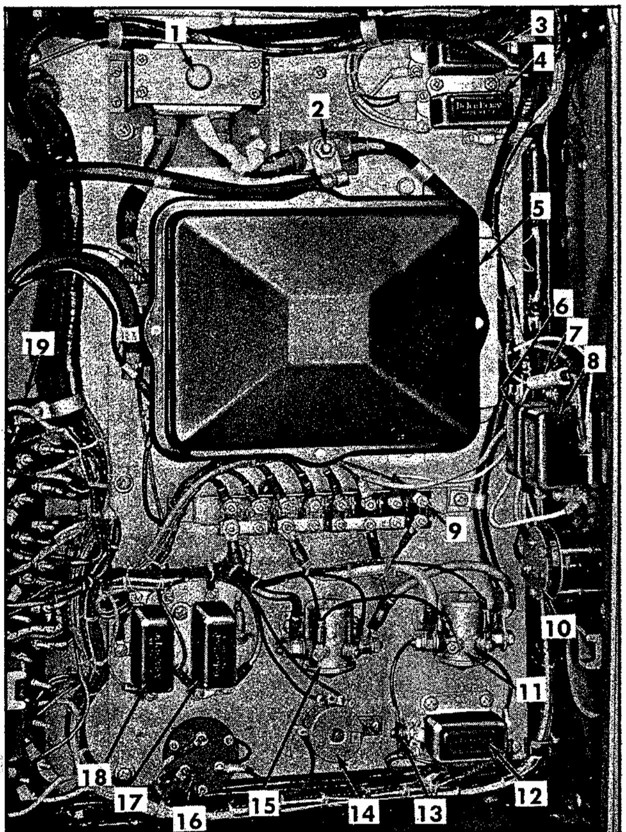


Figure 6—Driver's Control Panel Circuit Breaker Identification

Circuit Breaker No.	Size	Circuit	Wire Size & Color
6	20 Amp.	Engine Stop Solenoid & Speedo. Drive Unit	No. 14 Green
		*Water Booster Pump Relays & Switch	No. 14 Nat. - Red Tr.
		*Lavatory Control Relay	No. 14 Green
7	20 Amp.	Air Conditioning Test Ignition	No. 14 Brn. - Nat. Tr.
8	20 Amp.	Air Conditioning Choke	No. 14 Blk. - Nat. Cr. Tr.
9	20 Amp.	Directional Signal Flasher	No. 16 Blk. - Yellow Ch.
10	8 Amp.	Destination Sign Switch	No. 16 Brn. - Blk. Cr. Tr.
		Marker Light Switch	No. 14 Nat. - Blk. Tr.
		*Passenger Signal Switch (Special Hook-up)	No. 16 Orange - Nat. Tr.
11	20 Amp.	Headlight Switch	No. 14 Blk. - 2 Grn. // Tr.
12	20 Amp.	Reading and General Lighting Switch	No. 16 Blk. - Grn. Tr.
13	-	Spare	
14	20 Amp.	Defroster Switch	No. 14 Yellow - 2 Blk. // Tr.
15	20 Amp.	Horn Relay	No. 10 Red - Nat. Cr. Tr.
		*Seat Light Switch	No. 16 Green - Yell. Tr.
16	20 Amp.	Stop Light Switch	No. 14 Red - 2 Blk. // Tr.
17	20 Amp.	Driver's Fan Switch	No. 16 Brn. - 2 Red // Tr.
		Driver's Light Switch	No. 16 Yellow - Blk. Tr.
		*Windshield Fan Switch	No. 16 Red - 2 Blue // Tr.
		Baggage Compartment Light Switches	No. 16 Brn. - 2 Red // Tr.
18	20 Amp.	Heating and Cooling Master Switch	No. 14 Blk. - 2 Red // Tr.

*Equipment Not Standard.



1 Master Circuit Breaker
2 Battery Junction
3*Booster Water Pump Relay
4*Booster Water Pump Control Relay
5 Regulator
6*Lavatory Control Relay
7*Lavatory Ventilator Blower Motor Fuse
8*Lavatory Blower Relay (Greyhound Only)
9 Circuit Breaker Panel
10*Lavatory Water Pump Limit Switch
11 Reading Light Magnetic Switch
12*Temperature Switch Relay
13*Temperature Switch Relay Rectifier
14*Safety Control System Rectifier
15 General Lighting Magnetic Switch
16*Safety Control Relay
17 Reverse Relay
18 Starter Relay
19 Junction Panel

TPM-5380

* Special Equipment.

Figure 7—Electrical Compartment

ELECTRICAL COMPARTMENT

Electrical compartment (fig. 7) is located at right rear corner of coach behind right rear wheelhouse. To open compartment door, insert fingers under door latch handle, located in center of door at lower edge, then pull out and up on handle to unlatch door. Raise door to full open position and insert pin through holes in telescoping brace to hold door open. To close door, remove pin from brace and lower door. DO NOT DROP DOOR TO CLOSED POSITION. To lock door, lift up on door latch, push door closed, then push latch down and in flush with door.

The following standard items are installed in the electrical compartment (fig. 7):

Master Circuit Breaker
Battery Junction
Generator Regulator
Circuit Breaker Panel
Reading Light Magnetic Switch
General Lighting Magnetic Switch
Reverse Relay
Starter Relay
Junction Panel

The following special equipment items, indicated by an asterisk (*) on caption list for figure 7 are mounted in the electrical compartment:

Booster Water Pump Relay
Booster Water Pump Control Relay
Lavatory Control Relay
Lavatory Ventilator Blower Motor Fuse
Lavatory Blower Relay (Greyhound Only)
Lavatory Water Pump Limit Switch
Engine Temperature Switch Relay
Engine Temperature Switch Relay Rectifier
Safety Control System Rectifier
Safety Control Relay (Engine Shut-off Thermal Relay)

ELECTRICAL COMPARTMENT JUNCTION PANEL

Junction panel in electrical compartment (fig. 7) contains terminal posts numbered from 1 through 48. Numbers on panel correspond to numbers on Wiring Diagrams and in the tabulation which follows. The tabulation lists each terminal number, the circuit it carries, and the size, color, and pattern of the wires which connect to the terminal. A similar tabulation printed on a card is attached to a wiring harness in the electrical compartment. Some of the unused terminals, marked "open" or "spare" in the tabulation, may be used for special electrical equipment.

NOTE: Wires leading from the junction panels into the engine compartment are covered with a special black heat-resistant insulation. A tag on each black wire bears the number of the terminal to which it connects.

Refer to Symbol □ on Wiring Diagrams.

Terminal No.	Circuit	Wire Size & Color
1	Emergency Door Switch	No. 16 Blue - Blk. Tr.
2	Rear Marker Lights & Night Lights	No. 14 Nat. - Blk. Tr.
	Taillights	No. 14 Black
	*Lavatory Night Light	No. 16 Red
3	Starter Relay	No. 16 Red - Grn. Tr.
		No. 16 Black
4	Reverse Relay	No. 16 Nat. - 2 Red // Tr.
5	*Wheel Sanders	Grn. - Red Cr. Tr.
6	Speedometer Drive Unit	No. 14 Green
	Engine Comp't. Engine Stop Sw.	No. 14 Grn. & No. 14 Blk.
	*Engine Shut-off Relay	No. 14 Green
	*Lavatory Control Relay	No. 16 Dark Green
	*Water Booster Pump Switch	No. 16 Black
7	*Stop Overrule Switch	No. 14 Yellow - 2 Red // Tr.
	*Engine Shut-off Relay	No. 14 Yellow - 2 Red // Tr.
	*Engine Comp't Engine Stop Sw.	No. 14 Black
8	Generator Charge Indicator	No. 16 Brn. - Nat. Cr. Tr.
9	Right Side Reading Lights	No. 8 Blk. - Nat. Tr.
10	Open	
11	Right Rear Direct. Signal & Stop Light	No. 16 Nat. - Red Cr. Tr.
		No. 16 Black
12	Left Rear Direct. Signal & Stop Light	No. 16 Nat. - Blk. Cr. Tr.
		No. 16 Black
13	Emergency Stop Solenoid	No. 14 Nat. - Grn. & Red Cr. Tr.
		No. 14 Black
14	Left Side Reading Lights	No. 8 Blk. - Nat. Tr.
15	Oil Pressure Gauge	No. 16 Nat. - Blk. & Grn. // Tr.
		No. 16 Black
16	Engine Temperature Gauge	No. 16 Nat. - 2 Blk. // Tr.
		No. 14 Black
17	Low Oil Pressure Switch	No. 16 Nat. - Blk. & Grn. Cr. Tr.
		No. 16 Black
18	Engine Overheat Thermostat	No. 16 Yellow
		No. 14 Black
19	Right Side General Lights	No. 10 Black - Red Tr.
20	General Lighting Relay	No. 16 Black - Red Tr.
21	Reading Light Relay	No. 16 Black - Nat. Tr.
22	Starter Solenoid	No. 10 Nat. - Grn. Cr. Tr.
		No. 10 Black
23	Generator Charge Indicator	No. 16 Grn. - Red Tr.
	Engine Compartment Lights	No. 16 Black
	Engine Compartment Starter Switch	No. 16 Black
	*Lavatory Emergency Buzzer Switch	No. 16 Gray
24	Left Side General Lights	No. 10 Black - Red Tr.
25	Starter Cut-out Switch	No. 16 Blue - Nat. Tr.
		No. 16 Black
26	Reverse Solenoid	No. 10 Nat. - Blk. Cr. Tr.
		No. 10 Black
27	Open	
28	Open	
29	Reverse Relay Ground	No. 14 Black
30	Speedometer Drive Unit (A Terminal)	No. 16 Brn. - Nat. & Blk. Cr. Tr.
		No. 16 Black
31	Speedometer Drive Unit (D Terminal)	No. 16 Nat. - Blk. & Red // Tr.
		No. 16 Black
32	Speedometer Drive Unit (C Terminal)	No. 16 Grn. - 2 Red // Tr.
		No. 16 Black
33	Speedometer Drive Unit (B Terminal)	No. 16 Black - 2 Brn. // Tr.
		No. 16 Black
34	*Fire Detectors	Green - Nat. Cr. Tr.
35	*Tachometer	Blue
36	*Heat-on Tell-tale or *Tachometer	No. 16 Brown
37	*Heating Control Relay or *Tachometer	No. 16 Green
38	*Tachometer	Blue - 2 Nat. // Tr.
39	Open	
40	*From No. 39 Control Panel Jct.	No. 14 Grn. - Brn. Cr. Tr.
	*To Right Side Seat Lights	No. 16 Blk. - Green Line
41	Open	

*Equipment Not Standard.

Continued on next page.

Terminal No.	Circuit	Wire Size & Color
42	*Lavatory Emergency Buzzer	No. 16 Gray
43	Open	
44	Open	
45	Open	
46	*Water Booster Pump Control Relay	No. 14 Nat. - Red. Tr.
47	*Water Booster Pump	No. 14 Black
48	*Water Booster Pump Control Relay	No. 14 Grn. - Red Cr. Tr.

*Equipment Not Standard.

ELECTRICAL COMPARTMENT CIRCUIT BREAKERS

Circuit breaker panel, located below generator regulator in electrical compartment (fig. 7), has space for eight automatic-reset type circuit breakers. On vehicles with standard electrical equipment, only seven circuit breakers are used as shown in figure 8, with number 7 position blank. On vehicles equipped with lavatory, a circuit breaker is used in space number 7, and numbers 5, 6, and 7 are connected by a bus bar as shown in figure 7.

Circuit breakers protect various electrical circuits as indicated in the tabulation which follows. Any condition which causes an overload on a circuit will cause the circuit breaker bimetal element to open the circuit; when element cools, circuit breaker will again close the circuit. This on and off cycle will repeat until the switch controlling the defective circuit is turned off, or until the cause of the overload has been located and corrected. In the event a circuit breaker becomes defective (burns out or sticks closed), the defective circuit breaker must be replaced.

Circuit breaker numbers shown on Wiring Diagrams and in the tabulation which follows do not appear on the circuit breakers or on the panel. To identify circuit breakers by number, count from left to right, or refer to the diagram shown in figure 8.

The following tabulation lists each circuit breaker number (as identified in figure 8), amperage rating, the circuit it protects, and the size, color, and pattern of the wire (or wires) which connect to each circuit breaker terminal. Battery sides of number 1 and 2, 3 and 4, and 5 and 6 (and 7 when used) are connected by separate bus bars. Number 1 and 2 circuit breakers are fed from the battery through the general lighting magnetic switch when "GEN'L-READ" switch is placed in "GEN'L" position. Number 3 and 4 circuit breakers are fed from the battery through the reading light magnetic switch when magnetic switch is energized; reading light magnetic switch may be energized by one of four switches, depending upon the hook-up used, as follows:

1. When "GEN'L-READ" switch is placed in "READ" position, where reading lights are controlled by the "GEN'L-READ" light switch.
2. When "HEADLAMP" switch is turned on, where reading lights are controlled by the headlamp switch.
3. When "MARKER" light switch is turned on, where reading lights are controlled by the marker light switch.
4. When "ENGINE STOP-RUN" switch is placed in "RUN" position, where reading lights are controlled by the Diesel control switch.

These different hook-ups are indicated on "Coach Lighting Wiring Diagram."

Numbers 5 and 6 (and 7 when used) are fed from the battery terminal of the general lighting magnetic switch. Number 8 is fed from the "ARM" terminal on the generator regulator.

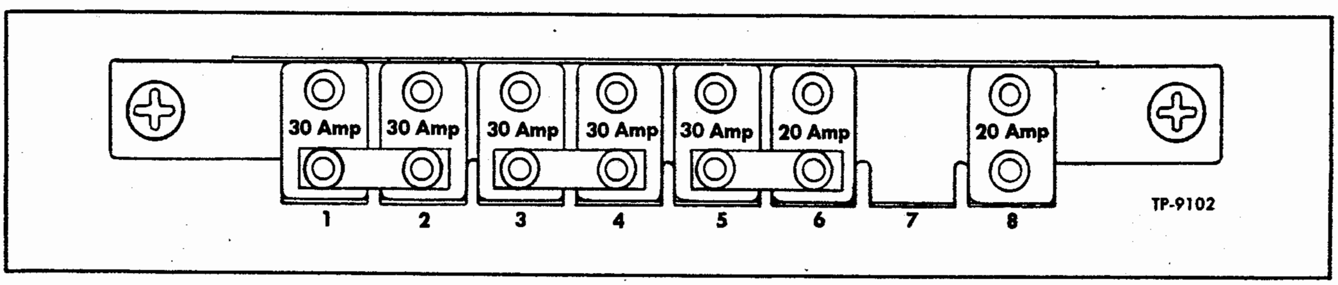


Figure 8—Electrical Compartment Circuit Breaker Identification

Circuit Breaker No.	Size	Circuit	Wire Size & Color
1	30 Amp.	Feed From General Lighting Magnetic Switch . .	No. 6 Green
		To Right Side General Lights	No. 10 Blk. - Red Tr.
2	30 Amp.	To Left Side General Lights	No. 10 Blk. - Red Tr.
3	30 Amp.	Feed From Reading Light Magnetic Switch . . .	No. 4 Natural
		To Right Side Reading Lights	No. 8 Blk. - Nat. Tr.
4	30 Amp.	To Left Side Reading Lights	No. 8 Blk. - Nat. Tr.
5	30 Amp.	To Starter Relay	No. 10 Red
6	20 Amp.	Feed From Batt. Post on Gen'l Light Relay . .	No. 10 Red
		To No. 23 Junction Terminal	No. 16 Grn. - Red Tr.
		To No. 23 Junction Terminal	No. 16 Black
7	20 Amp.	To Lavatory Control Relay	No. 14 Orange
8	20 Amp.	Feed From "Arm" Terminal on Regulator . . .	No. 14 Brn. - Nat. Cr. Tr.
		To No. 8 Junction Terminal	No. 16 Brn. - Nat. Cr. Tr.

HEATING AND COOLING JUNCTION PANEL

(With GM Heating and Air Conditioning)

Junction panel is mounted on forward wall of air conditioning engine compartment. Terminal posts on panel are numbered from 1 through 11. The tabulation which follows lists each terminal number, the circuit it carries, and the size, color, and pattern of the wire (or wires) which connect to the terminal (on coaches equipped with GM Heating and Air Conditioning only).

Terminal No.	Circuit	Wire Size & Color
1	Blower Low Speed Magnetic Switch	No. 14 Nat. - Grn. & Red // Tr.
2	Air Cond. Engine Test Ignition Switch	No. 14 Brown - Nat. Tr.
3	Air Cond. Engine Start Switches	No. 14 Green - Red Ch.
	Fuel Pump Relay "S" Terminal	No. 14 Green - Red Ch.
	Magneto Cut-out Relay "S" Terminal.	No. 14 Black
	Low Oil Pressure Switch	No. 14 Black
4	Air Cond. Starter Magnetic Switch	No. 14 Black
	Fuel Pump Relay "Amm" Terminal	No. 14 Orange - Red Tr.
5	Air Cond. Engine Low Oil Tell-tale and Fuel Pump Relay "C" Terminal	No. 16 Nat. - Red Ch.
	Low Oil Pressure Switch	No. 14 Black
6	Air Conditioning Engine Choke	No. 14 Black - Nat. Cr. Tr.
		No. 14 Black
7	Blower High Speed Magnetic Switch	No. 14 Black - Brn. Cr. Tr.
8	Air Conditioning Hi-Lo Pressure Switch	No. 14 Blue
9	Open	
10	Generator Charge Indicator	No. 16 Brn. - Nat. Cr. Tr.
11	Open	

BATTERY JUNCTIONS

Battery junctions are located in several places on the vehicle. Battery cables, carrying current to various parts of the vehicle for operation of the electrical units and systems, are connected at these junctions. Connections must be kept clean and tight. If corroded, disconnect cables and thoroughly clean cable ends and junction studs. Reconnect cables to junction studs and tighten stud nuts firmly. Locations of battery cable junctions are as follows:

1. Battery Compartment Junction, located on wall of battery compartment at rear end of upper battery, is accessible after opening battery compartment door.

2. Electrical Compartment Battery Junction, located above regulator in electrical compartment (fig. 7), is accessible after opening electrical compartment door.

3. Engine Compartment Battery Junction, located approximately in the center of the engine compartment bulkhead on the engine side, is accessible through the engine compartment doors.

4. Driver's Control Panel Battery Junction, located at bottom of junction panel at left of driver (fig. 5), is accessible after the junction panel cover is removed.

5. Air Conditioning Compartment Battery Junction, located on forward wall of air conditioning engine compartment, is accessible through the air conditioning engine compartment door.

MISCELLANEOUS JUNCTIONS

HEADLIGHT JUNCTION BLOCKS

Headlight junction blocks contain four screw-type terminals. Terminals are not numbered. When connecting wires, wire colors and patterns must be matched. Left headlight junction block is located in tool compartment at left front corner of vehicle and is accessible after opening compartment door. Right headlight junction block is mounted on lower dash panel at right side and is accessible through headlight opening. Refer to "LIGHTING SYSTEM" later in this group for headlight removal.

BODY JUNCTION BLOCKS

Body junction blocks, one on each side of vehicle, are located at top of window posts directly above rear wheelhousings. Junction blocks are accessible after removing reading light panels above rear wheelhousings. Each junction block contains six terminal posts. Terminals are numbered 1 through 6. Right side body junctions are indicated by the symbol ⬡ on Wiring Diagrams. Left side body junctions are indicated by the symbol ○.

PACKAGE RACK JUNCTION BLOCKS

Package rack junction blocks, one on each side of vehicle, are located in package rack rail at the second package rack brace from the rear. Junction blocks are accessible after removing next to rear cover from top of package rack rail. Each junction block contains three terminals, numbered 1, 2, and 3. Right side package rack junctions are identified by the symbol ◎ on "Coach Lighting Wiring Diagram." Left side package rack junctions are indicated by the symbol □.

BLOWER CIRCUIT BREAKERS

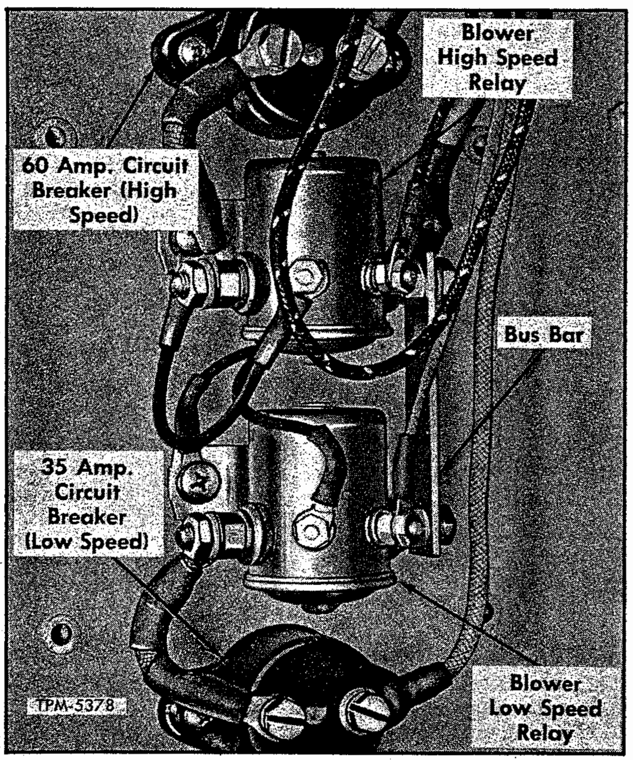


Figure 9—Blower Magnetic Switches and Circuit Breakers

Heating and air conditioning blower circuit breakers, together with high and low speed magnetic switches, are mounted on rear wall of heating compartment. Units are accessible after opening heating compartment door and removing circuit breaker and switch cover (fig. 9). Blower motor has two windings, low speed and high speed, and each circuit is controlled by a separate magnetic switch and protected by a separate circuit breaker. Low speed circuit breaker is of 35-amp capacity and high speed circuit breaker is of 60-amp capacity. Circuit breaker connections are shown on "Heating and Ventilation" wiring diagrams.

Circuit breakers are automatic reset type. Any condition which causes an overload on a circuit will cause circuit breaker bimetal element to open the circuit; when element cools, circuit breaker will again close the circuit. This off and on cycle will repeat until the switch controlling the defective circuit is turned off, or until the cause of the overload has been located and corrected. In the event a circuit breaker becomes defective (burns out or sticks closed), the defective circuit breaker must be replaced.

TELL-TALE ALARM SYSTEM

TELL-TALE LIGHTS

Space is provided in switch and tell-tale panels in front of driver (fig. 1) for twelve tell-tale lights. Eight tell-tale lights are used on each vehicle in conjunction with standard electrical equipment; others are used with special equipment. Tell-tale identification, shown in dotted circles in figure 1, is visible only when the light bulb under the lettering is illuminated. "ENGINE STOP-RUN" switch on left switch panel must be in "RUN" position to energize all tell-tale circuits except "HI BEAM,"

"STOP," and "DIRECT." Following is a list of all tell-tale lights with a brief description of their purpose and a reference to the Wiring Diagram on which the circuit is shown. Refer to figure 1 for location of tell-tales in panels.

1. "COOL. LOW OIL." This tell-tale is used in conjunction with GM air conditioning system. Tell-tale illuminates when air conditioning engine low oil pressure switch closes the circuit, indicating that some abnormal condition has caused the air conditioning engine to stop. Conditions which will cause engine to stop and illuminate the tell-tale are: Low oil pressure, engine overheated, or out of fuel. If tell-tale illuminates during operation, the heating and cooling "MASTER SWITCH" should be turned off. Refer to "Heating and Ventilating Wiring Diagram" (MD-77489).

2. "A.C. STOP." This tell-tale is used in conjunction with McGraw air conditioning system. Tell-tale serves the same purpose as the tell-tale used with GM air conditioning system described in 1 above. Refer to "Heating and Ventilating Wiring Diagram" (MD-84005).

3. "LOW AIR." This tell-tale, interconnected with the alarm buzzer, indicates that air pressure is below 54 to 66 psi. This pressure will not efficiently operate the brakes. If tell-tale illuminates and buzzer sounds while vehicle is moving, stop vehicle immediately and correct the cause of air pressure loss. Refer to "Alarm and Signal Wiring Diagram" (MD-79109).

4. "ENG. LOW OIL." This tell-tale, interconnected to the alarm buzzer, indicates that engine lubricating oil pressure is below 3 psi. If tell-tale illuminates and buzzer sounds during operation, stop engine immediately and correct the cause of low oil pressure. On vehicles with standard electrical control system, refer to "Alarm and Signal Wiring Diagram" (MD-79109).

5. "HOT ENG." Tell-tale, interconnected to the alarm buzzer, indicates that the temperature of the engine is too high for safe operation. Engine should be stopped immediately and the overheated condition corrected. On vehicles with standard electrical control system, refer to "Alarm and Signal Wiring Diagram" (MD-79109).

NOTE: When coach is equipped with Safety Control Relay system, low oil pressure or hot engine will cause engine to stop automatically. There is, however, a delay of 15 to 20 seconds from the time the tell-tale illuminates until the engine is stopped. Operation of the Safety Control Relay system is described later in this section.

6. "EMERG. DOOR." This tell-tale, interconnected to the alarm buzzer, indicates that the emergency exit door is open or partially unlatched. Coach should be stopped and emergency door securely latched for passenger safety. Refer to "Alarm and Signal Wiring Diagram" (MD-79109).

7. "HI BEAM." This tell-tale illuminates when headlight high beam is being used. Refer to "Coach Lighting Wiring Diagram" (MD-75571).

8. "FOG." This tell-tale indicates that the fog lights are being used. Refer to "Coach Lighting Wiring Diagram (MD-75571).

9. "DIRECT." This tell-tale flashes on and off when directional signals are being used to indicate normal functioning of signals. If tell-tale fails to illuminate when directional signal lever is moved to right or left turn position, it is an indication of a burned out directional signal bulb. Refer to "Alarm and Signal Wiring Diagram" (MD-79109).

10. "STOP." This tell-tale illuminates when brakes are applied to indicate normal functioning of stop lights. If tell-tale does not illuminate when brakes are applied, it is an indication that one or both stop light bulbs are burned out. Refer to "Alarm and Signal Wiring Diagram" (MD-79109).

11. "HAND BRAKE." This special equipment tell-tale (when used) is interconnected with a switch mounted on hand brake cross shaft, a hand brake relay, and a buzzer, and serves as a signal to the driver to release the hand brake before starting the vehicle in motion. The alarm system circuit is fed through the master relay when "ENGINE STOP-RUN" switch is in "RUN" position. Two different methods of actuating the system are available as follows:

a. On some vehicles, the hand brake relay operating coil is energized from the generator armature, and the alarm system will operate only when the generator is charging; thus, if the driver accelerates the engine to start coach in motion when hand brake is applied, alarm buzzer will sound and tell-tale will illuminate. This hook-up is shown on "Hand Brake Alarm Wiring Diagram" (MD-84276).

b. On other vehicles, the hand brake relay operating coil is energized from the transmission shift lever stop overrule switch which is closed only when transmission is shifted into low (1st) gear; thus, if transmission is shifted into low when hand brake is applied, alarm buzzer will sound and tell-tale will illuminate. This hook-up is shown on "Hand Brake Alarm Wiring Diagram" (MD-84025).

12. "HEAT ON." This tell-tale, used only on vehicles equipped with V.C.H. Heating System, lights when heating water valve is open, and cycles on and off as heating valve opens and closes. Purpose of tell-tale is to indicate normal functioning of heating system controls. Refer to "Heating and Ventilation Wiring Diagram" (MD-84005).

TELL-TALE ALARM BUZZERS

ALARM SIGNAL BUZZER
AND RECTIFIER ASSEMBLY

Alarm buzzer and rectifier assembly is mounted on control panel at left of driver (3, fig. 5). Buzzer and rectifier is interconnected with the "LOW AIR," "ENG. LOW OIL," "HOT ENG.," and "EMERG. DOOR" tell-tales and their controlling switches, and functions as previously described under tell-tale lights. Refer to "Alarm and Signal Wiring Diagram" (MD-79109) for electrical circuits. The rectifier portion of the unit permits current flow in one direction only. Since four different circuits will operate the buzzer, the rectifier prevents backfeed of current when one abnormal condition exists from illuminating the other tell-tales.

Tell-tale and buzzer circuits can be checked for continuity, referring to the "Alarm and Signal Wiring Diagram" (MD-79109). The "ENGINE STOP-RUN" switch on left switch panel must be in "RUN" position to energize the circuits. When checking hot engine tell-tale circuit, engine overheat thermostat terminal must be grounded.

Buzzer points can be cleaned, point opening can be adjusted, and the unit can be adjusted to buzz at a specified amperage. Refer to "Specifications" at end of this section.

HAND BRAKE ALARM BUZZER

Hand brake alarm buzzer (when used) is mounted on control panel at left of driver (1, fig. 5). Buzzer is interconnected with the "HAND BRAKE" tell-tale and switch as previously described in item 11 under "Tell-tale Lights." Refer to "Hand Brake Alarm Wiring Diagram" (MD-84276 or 84025), to check hand brake alarm buzzer and tell-tale circuit continuity. On type shown on MD-84276, "ENGINE STOP-RUN" switch must be in "RUN" position and generator must be charging to energize circuits. On type shown on MD-84025, "ENGINE STOP-RUN" switch must be in "RUN" position and transmission shift lever must be in low (1st) gear to energize the circuits.

Buzzer points can be cleaned, point opening can be adjusted, and the unit can be adjusted to buzz at a specified amperage. Refer to "Specifications" at end of this section.

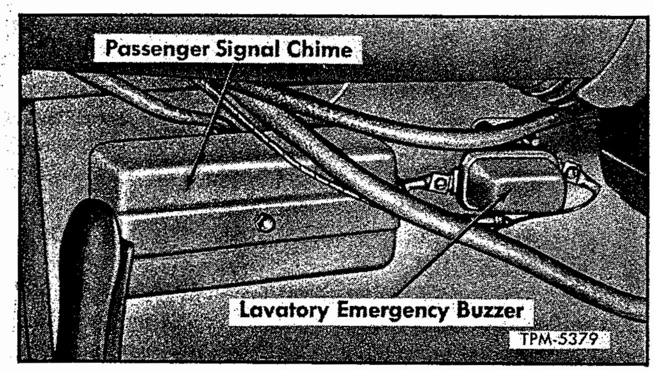


Figure 10—Lavatory Emergency Buzzer and Passenger Signal Chime

LAVATORY EMERGENCY BUZZER

Lavatory emergency buzzer is identical to the hand brake alarm buzzer. Lavatory emergency buzzer is mounted on front trim panel in front of driver at the left of the steering column (fig. 10). Buzzer is operated by a push button switch marked "TO SIGNAL DRIVER - EMERGENCY ONLY" on lavatory wall near door lock. To check circuit continuity, refer to "Lavatory Wiring Diagram" (MD-83294 or MD-84004). Circuit is fed hot from No. 6 circuit breaker in electrical compartment.

Buzzer points can be cleaned, point opening can be adjusted, and the unit can be adjusted to buzz at a specified amperage. Refer to "Specifications" at end of this section.

ALARM SWITCHES

Low oil pressure switch, engine overheat thermostat, and low air pressure switch are covered in other sections in this manual as previously indicated under "Index of Electrical Units." Emergency door switch and lavatory emergency buzzer switch require no service other than daily tests to make sure the circuits are operating properly. Hand brake alarm switch adjustment follows:

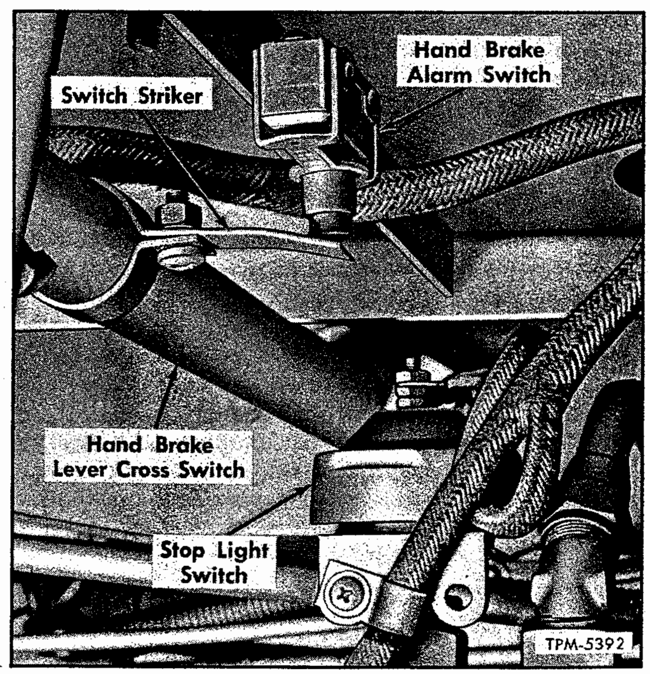


Figure 11—Hand Brake Alarm Switch and Striker

HAND BRAKE ALARM SWITCH ADJUSTMENT

Hand brake alarm switch is mounted on floor above hand brake lever cross shaft (fig. 11) and is accessible after opening tool compartment door at left front corner of vehicle. Switch contacts are spring-loaded in closed position, being held open by switch striker when hand brake lever is in fully released position. To adjust switch striker, place hand brake lever in fully released position, loosen clamp screws, and position striker arm so that switch plunger is held in. Tighten clamp screws firmly. After adjustment of switch striker, test alarm system to make sure it operates properly. On vehicles having the circuit actuated by the generator armature (MD-84276), apply hand brake and run engine at fast idle. On vehicles having circuit actuated by the transmission shift lever stop overrule switch (MD-84025), the "ENGINE STOP-RUN" switch must be in "RUN" position and the transmission shift lever in low (1st) gear position.

SAFETY CONTROL RELAY SYSTEM

Air-operated injector shut-off system, which automatically stops the engine when "ENGINE STOP-RUN" switch is placed in "STOP" position, is used as standard equipment on vehicles covered by this manual. Operation and maintenance of this system are covered in "DIESEL ENGINE ACCESSORIES" (SEC. 8).

Safety control relay system is used in conjunction with the air-operated injector shut-off system on some vehicles. The safety control relay system comprises the safety control relay, a rectifier, and on some vehicles equipped with a mercury tube type engine temperature switch, a temperature switch relay and rectifier. All of these units are mounted in the electrical compartment (fig. 7). These units are interconnected with the engine overheat and low oil tell-tale system and the engine shut-off magnet valve as shown on "Engine Control and Generator Wiring Diagrams" (MD-82893 and MD-83830). Operation of system with conventional engine overheat thermostat (MD-82893) is described below, followed by the differences occasioned when mercury tube type temperature switch and relay are used.

The safety control relay, with points normally closed, is connected to the "RUN" side of the "ENGINE STOP-RUN" switch through the master relay. Current for energizing the engine shut-off magnet valve, which must be energized with engine running, is fed through the closed points of the safety control relay. The safety control relay heating element is connected to the low oil pressure switch and to the engine overheat thermostat through the rectifier.

When low oil pressure switch or engine overheat thermostat contacts close, circuit is completed through the safety control relay heating element. Heat created in the heating element causes the relay contacts to open, breaking the circuit to the engine shut-off magnet valve. With magnet valve de-energized, air pressure is admitted to the injector shut-off air cylinder, and the injector racks are moved to no-fuel position, stopping the engine.

Action of the safety control relay is not immediate, as it requires 15 to 20 seconds for the unit to heat up sufficiently to open the contacts. Purpose of rectifier used with this system is to prevent back-feed of current from causing the system to function when the overheat thermostat or low oil pressure switch contacts are open.

NOTE: With engine stopped, low oil pressure switch contacts are closed. When "ENGINE STOP-RUN" switch is placed in "RUN" position, circuit through safety control relay heating element is completed immediately through the low oil pressure switch. If engine fails to start during the time required for the relay contacts to open (15 to 20 seconds), the system will cause the injector racks to be moved to no-fuel position (provided air pressure is available in the system). It is then necessary to use the "Stop Overrule" system described later.

With Mercury Tube Temperature Switch (MD-83830)

When mercury tube type temperature switch is used, the switch does not draw enough current to actuate the safety control relay; therefore, the temperature switch relay (12, fig. 7) is added to the system. The temperature switch current draw energizes the relay operating coil, closing the relay contacts; battery current is then fed through the relay contacts to the safety control relay heating element. The rectifier (13, fig. 7) is used to suppress inductance in the relay coil and prevent damaging the mercury column in the temperature switch.

STOP OVERRULE

When engine fails to start before the safety control relay breaks the circuit to the engine shut-off magnet valve, the safety control relay can be overruled. Make sure hand brake is fully applied. Depress clutch pedal and shift transmission into low (1st) gear. Switch mounted under floor and actuated by the transmission shift linkage will close and complete circuit to engine shut-off magnet valve, bypassing the safety control relay. While holding clutch pedal depressed, engage starter to start engine.

Stop overrule can also be used to move coach

off highway or out of danger if low oil pressure or overheated engine causes engine to stop.

SAFETY CONTROL RELAY SYSTEM TEST

Start engine and run for a few minutes to build up air pressure in air system. On vehicles with conventional engine overheat thermostat, ground the thermostat terminal. On vehicles with mercury tube type engine temperature switch, ground the "VAC" terminal on temperature switch relay (12, fig. 7) in electrical compartment. In either case, check time lapse before safety control relay system acts to stop the engine. Time should be 15 to 20 seconds. If engine does not stop within one minute, check operation of engine shut-off magnet valve and air cylinder before condemning the safety control relay. NOTE: Low voltage at relay will also cause slow relay action.

RELAYS

Relays are used in some instances to automatically open or close a circuit as operating conditions may require, and in other cases they are used to provide a direct connection between the battery and an electrically operated device, with only a small amount of current required to energize the relay operating coil flowing through the controlling switch. The later use eliminates the use of great lengths of heavy wire, thereby providing higher voltage to the electric device. Several of the same type relays may be used on each vehicle; however, they are used in different circuits for different purposes.

Location, operation, and adjustment of various types of relays are given later under individual headings. Before attempting adjustment of relays, make sure points are clean. Clean contact points with a thin, fine-cut contact file if pitted or burned. Refer to applicable Wiring Diagrams for relay circuits and to identify wires which connect to each relay terminal.

The following table lists each relay used, its location on the vehicle, and its part number. After determining part number of relay in table, refer to instructions under that part number for operation and adjustment.

Relay	Location	Number
*Blower Control	Driver's Control Panel (2, fig. 5)	1116845
*Booster Water Pump	Electrical Compartment (3, fig. 7)	1116797
*Booster Water Pump Control	Electrical Compartment (4, fig. 7)	1116852
Defroster	Defroster Heater Compartment (Fig. 26, Sec. 3)	1116797
*Defroster Booster Water Pump	Driver's Control Panel (4, fig. 5)	1116797
*Engine Temperature Switch	Electrical Compartment (12, fig. 7)	1116852
*Hand Brake Buzzer	Driver's Control Panel (16, fig. 5)	1116901
Horn	Driver's Control Panel (15, fig. 5)	1116818
*Lavatory Control	Electrical Compartment (6, fig. 7)	1116852
*Lavatory Ventilator Blower	Electrical Compartment (8, fig. 7)	1116852
Master Control	Driver's Control Panel (14, fig. 5)	1116852
Reverse	Electrical Compartment (17, fig. 7)	1116852
Starter	Electrical Compartment (18, fig. 7)	1116852
Stop Light	Driver's Control Panel (13, fig. 5)	1850547

*Special Equipment.

RELAY 1116797

Three of these relays may be used on each vehicle. Defroster blower relay is used as standard equipment on all vehicles. Booster water pump relay and defroster booster water pump relay are used only on vehicles equipped with booster water pump. Location and function of each relay are described under individual headings. Adjustment instructions apply to either of the three units. Adjustment points are shown in figure 12.

DEFROSTER BLOWER RELAY

Defroster blower relay is mounted in defroster heater compartment and is accessible after removing compartment panel (fig. 26, Sec. 3). Relay is used in defroster blower circuit to provide high and low speeds for defroster blower motors. When "DEFROST" switch (fig. 1) is placed in "HI" position, relay does not operate and blower motors are connected parallel for high speed operation. When switch is placed in "LO" position, relay operating circuit is energized, and the two motors are connected in series for low speed operation. Refer to "Heating and Ventilation Wiring Diagram" (MD-77489, MD-75683, or MD-84005) for circuits and connections. Relay operation is as follows:

"HI" Speed. Circuit is from "T" terminal at right side switch and tell-tale panel Amphenol connector, through No. 77 control panel junction,

through right side defroster motor, and to ground through the relay ground (G) terminal; from tapped junction in feed line through left side motor, through relay "B" terminal, armature, upper contacts (normally closed), and "S" terminal, then to ground through the relay ground terminal. With motor windings connected in this manner (parallel), both motors run at high speed.

"LO" Speed. Circuit is from "U" terminal at Amphenol connector through No. 67 control panel junction and relay "C" terminal and coil windings to ground through the relay ground (G) terminal. With coil energized, armature is pulled down, opening the upper contacts and closing the lower contacts. Circuit is then through relay "AMM" terminal and lower contacts to "B" terminal, through the left motor windings, through the right motor windings, then to ground through the relay ground terminal. With the resistance of both motors connected in series, current flow is reduced and blowers run at reduced speed.

BOOSTER WATER PUMP RELAY

Booster water pump relay, mounted in electrical compartment (3, fig. 7), carries current to the booster water pump whenever pump is operated, either by the defroster blower switch, by the automatic heat control system, or by the manual water pump switch. Electrical circuits and connections are shown on "Heating and Ventilation Wiring Diagram" (MD-84005). Circuits are as follows:

a. When pump is operated by manual switch or by automatic heat control system, circuit is from the "Water Pump Control Relay" to the booster water pump relay "S" terminal, through the normally closed upper contacts to the "B" terminal, to No. 47 electrical compartment junction, to water pump motor.

b. When pump is operated by defroster switch, circuit is from the "Defroster Booster Water Pump Relay" to the booster water pump relay "C" terminal, through the relay operating coil to ground. With coil energized and armature attracted to core, lower contacts are closed and upper contacts are open. Circuit is then from the booster water pump relay "AMM" terminal, which is fed hot, through the lower contacts to the "B" terminal, through No. 47 electrical compartment junction to the water pump motor.

DEFROSTER BOOSTER WATER PUMP RELAY

Defroster booster water pump relay is mounted on driver's control panel (4, fig. 5). Purpose of relay is to provide operation of booster water pump whenever the defroster blower switch is turned on, either for "HI" or "LO" speed blower operation. Electrical circuits and connections are shown on "Heating and Ventilation Wiring Diagram" (MD-84005). Relay operation is as follows:

With "DEFROST" Switch in "HI." Circuit is from No. 77 control panel junction to relay "S" terminal, through the upper contacts (normally closed) to the "B" terminal, to No. 78 control panel junction, to No. 33 electrical compartment junction, to "Booster Water Pump Relay" operating coil. With this relay energized, current is supplied to booster water pump as previously explained in paragraph b under "Booster Water Pump Relay."

With "DEFROST" Switch in "LO." Circuit is from No. 67 control panel junction to relay "C" terminal, through relay operating coil to ground. With operating coil energized, armature is attracted to core, opening upper contacts and closing the lower contacts. Circuit is then from "C" terminal through jumper to "AMM" terminal, through lower contacts to "B" terminal to No. 78 control panel junction to No. 35 electrical compartment junction, then to "Booster Water Pump Relay" operating coil. With this relay energized, current is supplied to booster water pump as previously explained in paragraph b under "Booster Water Pump Relay."

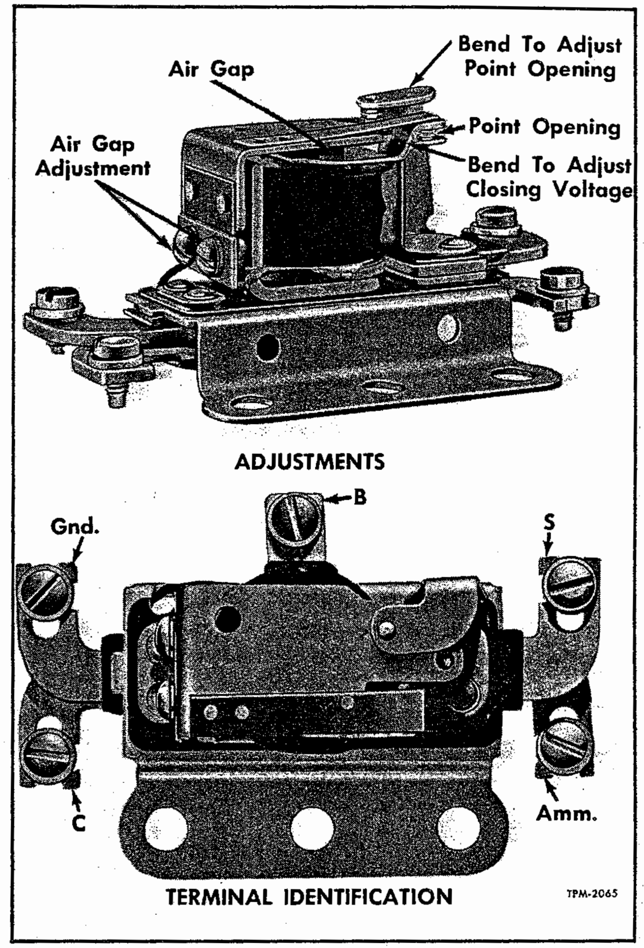


Figure 12—Relay 1116797

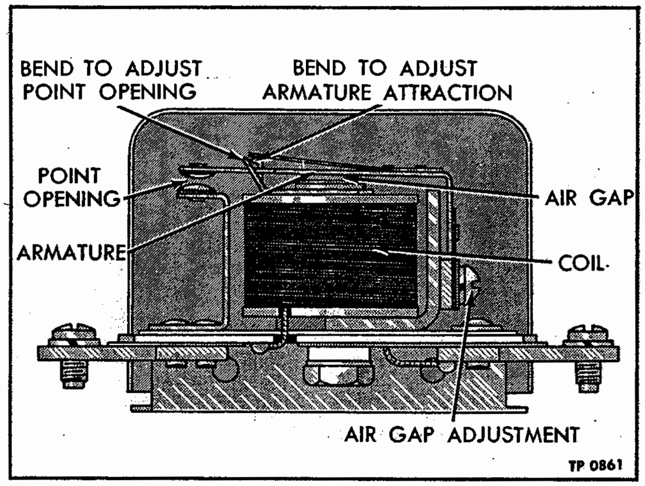


Figure 13—Relay 1116818

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing voltage.

Air Gap (Fig. 12)

Remove cover from relay. Press armature down until lower points just close and measure air gap between armature and core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as necessary. If necessary, bend the lower contact support so the air gap will be uniform across top of core.

Point Opening (Fig. 12)

Measure opening between lower points with upper points closed. Adjust point opening, if necessary, by bending the upper contact support.

Closing Voltage (Fig. 12)

Connect an accurate reading voltmeter parallel with the coil winding from "C" terminal to ground. Connect a variable resistance in series with the coil winding at the "C" terminal. Turn on applicable switch to energize the coil winding. Slowly decrease resistance until lower contacts close and note the reading on voltmeter. If not within range listed in "Specifications," adjust by bending the armature spring post to increase or decrease spring tension. Increasing spring tension increases the closing voltage, and decreasing spring tension decreases the closing voltage.

RELAY 1116818

This relay, used only in the horn circuit, is mounted on control panel at left of driver (15, fig. 5). Relay circuits and connections are shown on "Alarm and Signal Wiring Diagram" (MD-79109). Coil windings of the relay are connected in series with the horn button. When horn button is pressed, circuit through relay winding is completed, and armature is attracted to core. This completes the circuit from the "B" terminal through the closed points and "D" terminal to the horn.

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this section for air gap and point opening dimensions and for closing voltage.

Air Gap (Fig. 13)

Disconnect wire from "B" terminal and remove relay cover. Press armature down until points just touch and measure air gap between armature and core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and the armature.

Point Opening (Fig. 13)

With wire still disconnected from "B" terminal, measure contact point opening with armature up against stop. Adjust opening, if necessary, by bending the armature stop.

Closing Voltage (Fig. 13)

Connect an accurate reading voltmeter parallel with the operating circuit at the "B" and "S" terminals. Connect a variable resistance unit of 10 ohms in series with the operating circuit at the "B" terminal. With horn button pressed, slowly decrease resistance until points close and note the voltmeter reading. Adjust, if necessary, by bending the armature spring post to change tension of armature spring. Increasing spring tension increases the closing voltage, and decreasing spring tension decreases the closing voltage.

RELAY 1116845

This relay is used only as a blower control relay on vehicles equipped with VCH Heating and McGraw Air Conditioning System. Relay is mounted on control panel at left of driver (2, fig. 5). Purpose of relay is to provide high speed blower operation at all times when air conditioning is being used, regardless of the position of the blower switch. Blower high or low speed can be used with heating system only. Blower switch is fed through the off position of the coach Diesel engine starter switch so that the blower circuit is cut out during engine cranking. Blower control relay circuits and connections are shown on "Heating and Ventilation Wiring Diagram" (MD-84005). Relay operation is as follows:

With Air Conditioning "ENGINE CONTROL" Switch "OFF" and "BLOWER" Switch in "LO" Position. Circuit is from "LO" side of blower switch to relay "D" terminal, through normally

closed relay contacts to "B" terminal, then through No. 57 control panel junction and No. 1 air conditioning compartment junction to the blower low speed magnetic switch operating coil.

With Air Conditioning "ENGINE CONTROL" Switch "OFF" and "BLOWER" Switch in "HI" Position. Circuit is from "HI" side of blower switch through "OFF" side of air conditioning engine control switch, to "S" terminal of blower control relay which serves only as a junction point, then through No. 89 control panel junction, rectifier and No. 7 air conditioning compartment junction to blower high speed magnetic switch operating coil. Purpose of rectifier in high speed operating circuit is to prevent backfeed of current when operating blowers from the test panel in air conditioning compartment.

With Air Conditioning "ENGINE CONTROL" Switch "ON" and Blower Switch in Either Position. Circuit is from the "ON" side of the air conditioning engine control switch, through the "OFF" side of the air conditioning engine starter switch, back through the air conditioning engine control switch to the "S" terminal of the blower control relay. This energizes the relay operating coil and opens the relay points, which cuts out the low speed circuit in the event the blower switch is in "LO" position. Also from the "S" terminal of the relay, circuit is through No. 89 control panel junction, rectifier, and No. 7 air conditioning compartment junction to the blower high speed magnetic switch operating coil.

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for opening and closing voltage.

Air Gap (Fig. 14)

Remove cover from relay. Depress armature against lower stop and measure air gap between armature and core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, bend lower armature stop to obtain uniform gap between armature and core.

Point Opening (Fig. 14)

Measure point opening with armature depressed against lower stop. Adjust point opening, if necessary, by bending the upper contact point support.

Opening Voltage (Fig. 14)

Connect an accurate reading voltmeter parallel with the operating coil circuit from "S" terminal to ground. Connect a variable resistance unit in series with the operating coil circuit at the "S" terminal. (Resistance must be connected to the wire leading from the air conditioning engine control switch, and the wire leading to the blower magnetic switch must be disconnected during test.) Place air

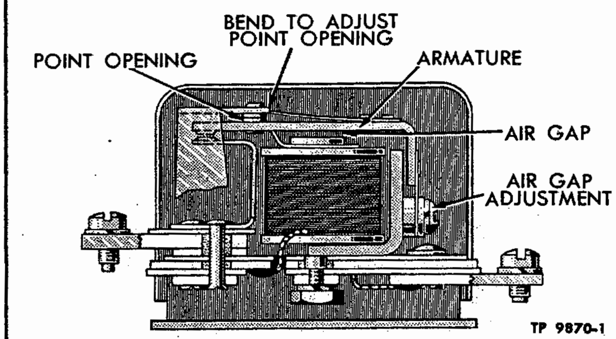


Figure 14—Relay 1116845

conditioning "ENGINE CONTROL" switch in "ON" position to energize the operating coil circuit.

Slowly decrease the resistance and note reading on voltmeter when points open. Increase resistance and note voltage at which points close. If not within limits listed in "Specifications" adjust by bending armature spring stop to change armature spring tension. Increasing spring tension increases opening voltage, and decreasing spring tension decreases opening voltage. After completing adjustment, remove instruments and reconnect wires to relay "S" terminal.

RELAY 1116852

Three of these relays are used as standard equipment on each vehicle, and four may be used as special equipment. Location and function of each relay are described under individual headings, followed by adjustment instructions which apply to all of the units. Relay adjustment points are shown in figure 15.

MASTER CONTROL RELAY

Master control relay is mounted on control panel at left of driver (14, fig. 5). Purpose of master relay is to complete circuit from battery to engine control units and switches when "ENGINE STOP-RUN" switch is in "RUN" position. Master relay circuits and connections are shown on many of the wiring diagrams included in back of this manual. Relay operation is as follows:

When "ENGINE STOP-RUN" switch is placed in "RUN" position, circuit is completed from battery to relay "VAC" terminal, through the relay operating coil, and to ground from the relay "GEN" terminal. With operating coil energized, armature is attracted to core and relay points close. With points closed, circuit is complete from battery (BAT terminal) through the points and "SOL" terminal to circuit breakers on control panel.

STARTER RELAY

Starter relay is mounted in electrical compartment (18, fig. 7). Purpose of relay is to complete circuit from battery to starter solenoid when the "STARTER" switch on switch panel in front of driver (fig. 1) or on engine compartment panel is closed. Relay circuits and connections are shown on "Engine Control and Generator Wiring Diagram" (MD-75606, MD-82893, or MD-83830). Relay operation is as follows:

When either starter switch is closed, circuit is completed to relay "VAC" terminal, through the relay operating coil to "GEN" terminal, and to ground through the starter cut-out switch, which must be closed. With operating coil energized, armature is attracted to core and relay points close. Currnet then flows from "BAT" terminal through points to "SOL" terminal, to No. 22 electrical compartment junction, and to starter solenoid operating coil through the engine compartment amphenol connector.

REVERSE RELAY

Reverse relay is mounted in electrical compartment (17, fig. 7). Purpose of relay is to complete circuit from battery to reverse solenoid on transmission when "REVERSE GEAR" switch on switch panel in front of driver (fig. 1) is closed. Relay circuits and connections are shown on "Engine Control and Generator Wiring Diagram" (MD-75606, MD-82893, or MD-83830). Relay operation is as follows:

When "REVERSE GEAR" switch is closed, circuit is completed to relay "VAC" terminal, through the relay operating coil to "GEN" terminal, and to ground through electrical compartment junction No. 29 and regulator ground terminal. With operating coil energized, armature is attracted to core and relay points close. Current then flows from "BAT" terminal through points to "SOL" terminal, to No. 26 electrical compartment junction, and to reverse solenoid windings.

LAVATORY CONTROL RELAY

Lavatory control relay, used on all coaches equipped with lavatory, is mounted in electrical compartment (6, fig. 7). Purpose of relay is to complete circuit to lavatory ventilation blower when "ENGINE STOP-RUN" switch is placed in "RUN" position. Circuits and connections are shown on "Lavatory Wiring Diagram" (MD-83294, or MD-84004). Operation of relay is as follows:

Relay "BAT" terminal is fed from No. 7 circuit breaker in electrical compartment. When "ENGINE STOP-RUN" switch is placed in "RUN" position, circuit is completed to relay "VAC" terminal, through relay operating coil to "GEN" terminal and ground. With operating coil energized, relay points close. Current from "BAT" terminal then flows through relay points to "SOL" terminal to lavatory ventilation blower. Refer to "LAVATORY" in BODY (SEC. 3) for detailed description of lavatory system.

LAVATORY VENTILATION BLOWER RELAY

Lavatory ventilation blower relay is used on Greyhound coaches equipped with lavatory. Relay is mounted in electrical compartment (8, fig. 7). Purpose of relay is to provide a means of operating the lavatory ventilation blower whenever lavatory door is closed and locked from inside, regardless of whether the coach engine is running or not. Relay circuits and connections are shown on "Lavatory Wiring Diagram" (MD-83294). Relay operation is as follows:

Relay "BAT" terminal and lavatory door latch switch are fed from No. 7 circuit breaker in electrical compartment. Whenever lavatory door is closed and locked, circuit is completed to relay "VAC" terminal, through operating coil to "GEN" terminal and ground. With operating coil energized, relay points close. Current from "BAT" terminal then flows through the closed points to "SOL" terminal and to lavatory ventilation blower.

ENGINE TEMPERATURE SWITCH RELAY

This relay is used on vehicles equipped with mercury tube type engine temperature switch. Relay is mounted in electrical compartment (12, fig. 7). Relay circuits and connections are shown on "Engine Control and Generator Wiring Diagram" (MD-83830).

This relay is required because the mercury tube type temperature switch does not draw enough current to actuate the safety control relay. The temperature switch current draw energizes the relay operating coil, closing the relay contacts; battery circuit is then complete through the relay contacts to the safety control relay heating element. Refer to "Safety Control Relay System" earlier in this section for operation of this system.

BOOSTER WATER PUMP CONTROL RELAY

This relay is used only in vehicles equipped with booster water pump to provide operation of water pump either by manual switch or by the automatic heat control system. Relay is mounted in electrical compartment (4, fig. 7). Relay circuits and connections are shown on "Heating and Ventilation Wiring Diagram" (MD-84005). Relay operation is as follows:

Relay "BAT" terminal is fed hot from No. 6 circuit breaker in electrical compartment. When booster water pump manual switch is closed or when heating control thermostat calls for heat, circuit is completed to the relay "VAC" terminal, through the relay operating coil to "GEN" terminal to ground. With operating coil energized, points

are closed. Circuit is then complete from "BAT" terminal through relay points to "SOL" terminal, which is connected to "S" terminal at "Booster Water Pump Relay." Refer to "Booster Water Pump Relay" under "Relay - 1116797."

RELAY ADJUSTMENTS

Refer to "Specifications" at end of this section for air gap and point opening dimensions and for closing values.

Air Gap (Fig. 15)

Disconnect leads from "BAT" terminal and remove relay cover. With contact points held closed, measure air gap between armature and center of coil. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and the armature.

Point Opening (Fig. 15)

With leads still disconnected from "BAT" terminal, measure contact point opening with armature up against stop. Adjust opening, if necessary, by bending the armature stop.

Closing Voltage (Fig. 15)

With all leads connected to the relay as shown on applicable Wiring Diagram, connect an accurate reading voltmeter in parallel with the relay operating circuit at the "VAC" and "GEN" terminals. In most cases, "ENGINE STOP-RUN" switch must be in "RUN" position to complete the circuits. Insert a variable resistance unit in series with the operating circuit at the "VAC" terminal. To check closing voltage, close the relay operating switch, then adjust resistance until points close and note the voltage reading. (For engine temperature switch relay, ground the "VAC" terminal of the relay to energize the operating coil.) Adjust, if necessary, by bending the armature spring post. Increasing spring tension increases the closing voltage, and decreasing spring tension decreases the closing voltage. After checking and adjusting voltage at which points close, check voltage at which armature seals to core.

RELAY 1116901

This relay (hand brake alarm relay) is used only on vehicles equipped with hand brake alarm buzzer and tell-tale system. Relay is mounted on control panel at left of driver (16, fig. 5). Relay circuits and connections are shown on "Hand Brake Alarm Wiring Diagrams" (MD-84025 and MD-84276). Relay operation is as follows:

Relay "BAT" terminal is fed from No. 5 circuit breaker through the master relay when "ENGINE STOP-RUN" switch is in "RUN" position. On system shown on MD-84025, relay operating coil is energized whenever transmission is shifted into 1st gear; on system shown on MD-84276, relay operating coil is energized whenever the generator is charging. In either case, with operating coil energized, the relay points are closed and circuit is complete to the hand brake alarm switch. When hand brake is applied, switch is closed and circuit is completed to ground, causing the alarm system to operate.

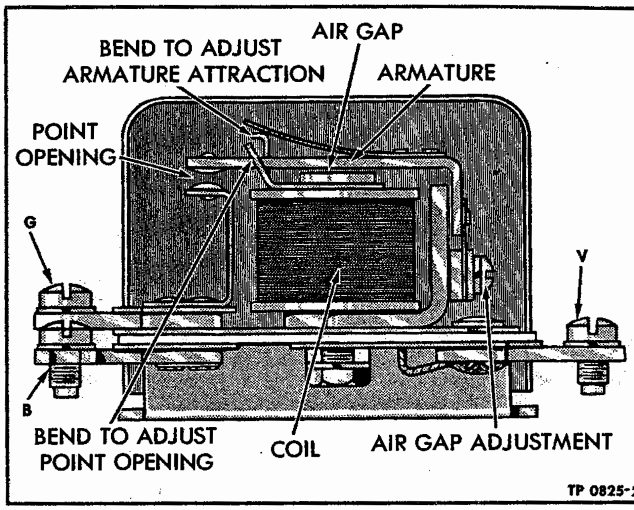


Figure 15—Relay 1116852 and 1116901

RELAY ADJUSTMENTS

Hand brake alarm relay is similar in appearance to relay 1116852 (fig. 15) and the adjustment points are identical. Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing and opening voltage.

Air Gap (Fig. 15)

Remove relay cover. Press armature down until points close and measure air gap between armature and center of coil core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and armature.

Point Opening (Fig. 15)

Measure contact point opening with armature up against stop. Adjust point opening, if necessary, by bending the armature stop.

Closing Voltage (Fig. 15)

Connect an accurate reading voltmeter parallel with the operating coil circuit. Connect variable resistance unit in series with the operating coil circuit. Energize the operating coil circuit as

follows: On vehicles having the relay energized from generator circuit (MD-84276), start engine and run at fast idle; on vehicles having relay energized through the transmission shift lever stop overrule switch, shift transmission into 1st gear with engine control switch in "RUN" position (engine should not be running). With operating coil circuit energized, slowly decrease resistance and note voltmeter reading when points close. Adjust if necessary, by bending the armature spring post to change tension on armature spring. Increasing spring tension increases closing voltage, and decreasing tension decreases closing voltage.

RELAY 1850547

This relay is used as a stop light tell-tale relay. Relay is mounted on control panel at left of driver (13, fig. 5). Relay circuits are shown on "Alarm and Signal Wiring Diagram" (MD-79109). Relay is similar in appearance to the horn relay (fig. 13) and the adjustment points are identical.

Relay is connected into the stop light and stop light switch circuit in such a manner that when the brakes are applied and stop light switch contacts close, current to stop lights passes through the relay coil winding. With coil winding energized, armature is attracted to core and relay points close, completing the circuit to the "STOP" telltale in right switch panel, indicating that the stop lights are illuminated.

Stop light tell-tale relay is sensitive to amperage, requiring the current draw of both stop light bulbs to close the points. If one bulb is burned out, current draw will not be sufficient to close the relay points, and stop light tell-tale will not illuminate when brakes are applied. When the directional signal lights are being used and brakes are applied, one bulb is intermittently taken out of the circuit to produce the directional signal. To prevent relay points from opening under these conditions, a resistor, installed on control panel at left of driver (fig. 5), is connected into the flasher circuit in such a manner that the resistor is placed into the circuit when the stop light bulb is taken out by the flasher. This provides constant current draw sufficient to keep the relay points closed.

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing amperage.

Air Gap (Fig. 13)

Remove relay cover. Press armature down until points just close and measure air gap between armature and core. Adjust, if necessary, by loosening two screws and moving armature up or down as required. If necessary, align the support carrying the lower contact so the air gap will be uniform between the coil and the armature.

Point Opening (Fig. 13)

Measure contact point opening with armature up against stop. Adjust opening, if necessary, by bending the armature stop.

Closing Current (Fig. 13)

Connect an accurate ammeter and a variable resistance unit in series with the operating circuit at the "S" terminal. Apply brakes, or connect a jumper lead across the stop light switch points to complete the circuit. Slowly decrease resistance until points close and note reading on ammeter. Increase resistance until points open and note reading on ammeter. If closing and opening amperage is not within limits listed in "Specifications," adjust by bending armature spring post to increase or decrease spring tension. Increasing spring tension increases closing amperage, and decreasing spring tension decreases closing amperage.

If relay does not function properly during normal operation in vehicle, candlepower of stop light bulbs should be checked. Stop light bulbs of proper size must be used.

MAGNETIC SWITCHES

Four identical magnetic switches are used on each vehicle. Magnetic switches actually serve as heavy duty relays, being used in circuits where the current demands exceed the capacity of a conventional coil and armature type relay.

Two magnetic switches, mounted in electrical compartment (11 and 15, fig. 7), serve as relays in the general lighting and reading light circuits. When light switch at bottom of right switch panel in front of driver (fig. 1) is placed in "GEN'L" or "READ" position, the coil winding in the applicable magnetic switch is energized. With magnetic switch winding energized, switch contacts close, completing circuit direct from battery to lights. Circuit through light switch and magnetic switch windings is protected by No. 12 circuit breaker on panel at left of driver's seat. Circuit from each magnetic switch to the lights it controls is protected by two circuit breakers in the electrical compartment. Refer to "Coach Lighting Wiring Diagram" (MD-75571) for circuits and connections.

Two blower magnetic switches, together with circuit breakers, are mounted on rear wall of heating compartment. Units are accessible after opening heating compartment door and removing circuit breaker and switch cover (fig. 9). When blower

high or low speed magnetic switch coil winding is energized, the switch contacts close and complete the circuit from battery to blower high or low speed winding. Circuit to low speed winding is protected by a 35 amp circuit breaker, and circuit to high speed winding is protected by a 60 amp circuit breaker. Circuits and connections are shown on either of the three "Heating and Ventilation Wiring Diagram" (MD-77489, MD-75683, or MD-84005).

Magnetic switches are sealed units and are not adjustable or reparable. If either switch fails to function properly, the defective unit must be replaced.

ELECTRIC HORN

Horn (fig. 16) operates on magnetic principle to produce warning signal. Current from battery flows through windings within horn when circuit is completed by action of a relay when horn button is pressed. Horn circuit is protected by No. 15 circuit breaker on panel at left of driver. Refer to "Alarm and Signal Wiring Diagram" (MD-79109) for horn circuit.

HORN TESTS

If horn produces a weak signal, voltage at horn should be checked by connecting a voltmeter across horn terminals. The voltage reading should not be less than 11 volts. A lower reading indicates either a low battery or high resistance in horn circuit.

Loose or corroded connections in horn circuit should be corrected. Check for defective wiring by connecting separate test leads from horn to battery.

A loose connection or poor contact at horn push button may cause horn to operate intermittently. Shunt around horn button to determine whether there is poor contact at push button. Whenever wiring is replaced in horn circuit, use correct size as shown on wiring diagram.

Horns usually have a rasping sound when vital parts are broken or loose. A loose back shell may affect tone. Tighten collar screws, mounting nuts, and studs. Replace all damaged parts.

The horn will not function properly if field windings within horn are open circuited or grounded. Connect an ammeter in circuit at horn terminal. If there is no indication of current flowing when contact points are closed, windings are open circuited. The ammeter will indicate an excessive flow of current if windings are short circuited or grounded.

Windings may also be checked for grounded circuit with test lamp having its own source of current. Disconnect horn leads and touch one test point to one of the horn terminals and the other point to the horn base. If lamp lights, field windings are grounded.

Excessive arcing at contact points may be caused by improper current adjustment. An open circuit in condenser will cause excessive arcing at points and, in some cases, contacts will be held together.

HORN ADJUSTMENTS

If tone is not satisfactory after checking preceding conditions, adjust horn in following manner:

1. Remove shell from horn.
2. Connect ammeter in circuit at horn and adjust current consumption by varying position of adjusting nut. Refer to "Specifications" at end of this group for current consumption.
3. Loosen adjusting lock nut and turn adjusting nut to left or right to increase or decrease current.
4. Too much current will cause horn to have a spluttering sound. This adjustment is very sensitive. Move nut 1/10 turn at a time and lock in position each time before trying. If ammeter is not available, adjust according to sound.
5. Correct air gap between armature and core is important for proper tone. The gap must be uniform across entire surface of armature. Width of gap may be determined by using a feeler. Adjustments are made by use of air gap adjusting nuts. Refer to "Specifications" at end of this group for correct adjustment dimensions.

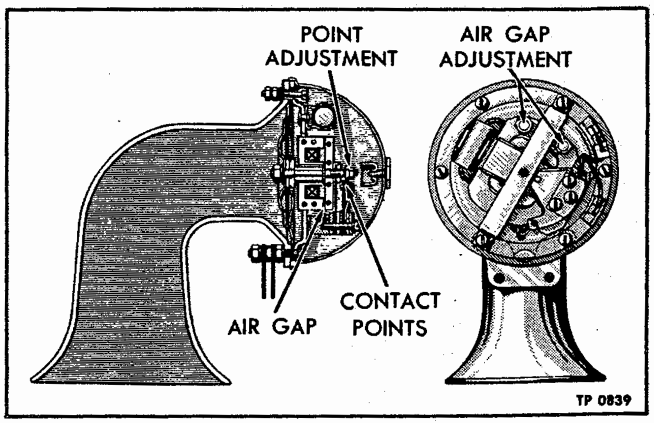


Figure 16—Electric Horn

ELECTRIC SPEEDOMETER

The electric drive unit is mounted in engine compartment and driven by a short flexible cable from the transmission speedometer drive gears. A four wire conductor cable plugged into drive unit is connected to an electric motor unit mounted on back of mechanical speedometer head in instrument panel. Electric motor drives speedometer when actuated by electrical impulses from drive unit. Drive unit uses 12 volt current from battery or generator. Circuit is protected by No. 6 circuit breaker on panel at left of driver's seat.

Electric speedometer wiring is shown on "Alarm and Signal Wiring Diagram" (MD-79109).

Current is divided in drive unit by a mechanically driven rotor with two brushes which run against a resistor ring. Varying currents are transmitted to motor on speedometer head through a four wire cable.

Electrical currents from drive unit energize two pairs of coils in motor unit, causing magnetic rotor to rotate at exactly same speed as mechanically driven unit. Since motor is coupled to speedometer head, rotation is transformed to a reading on face of calibrated speedometer head. Thus, a synchronized electrical drive supplants the standard drive cable.

TESTING

For testing speedometer electrical units (using battery of 12 volts), plus or minus one volt variation is permissible. The maximum current consumption should not exceed two amperes.

Jam nut, located at point where four wire conduit fastens to connector plugs, should always be kept tight. The connector plug body grips cable insulation and prevents conduit coming loose from connector plugs due to rough handling which would cause loose connections.

A test light (1568147) should be used to test electric speedometer. If speedometer ceases to function, proceed as follows:

1. Check test light bulbs with battery to be sure they are not burned out.
2. Pull four-contact plug out of top of drive unit and insert plug on end of light cable in its place.
3. Turn engine control switch to "RUN" position to energize drive unit.
4. Disconnect flexible drive shaft at transmission. Turn drive shaft slowly by hand. If lights alternately grow bright and dim, the drive unit is functioning properly.
5. Remove test light cable plug from drive unit and reconnect cable to drive unit.
6. Disconnect cable plug from speedometer head motor and connect to test light cable, using double end male adapter chained to end of cable.
7. Again turn drive shaft slowly by hand. If lights alternately go bright and dim, wiring between drive unit and head is good and trouble should be in head unit.
8. Always be sure that plugs make good contact when connected.
9. If lights fail to check when connected to unit, check feed and ground connections at drive unit for tightness; also for broken flexible drive shaft.
10. If lights check when connected to drive unit but not when connected at front of cable, careful check should be made of electrical cable for broken wire or loosen connections where wires attach to sockets.

With above procedure, it will be easy to determine whether trouble lies in drive unit, in connector plug and wiring, between drive unit and motor unit, or in motor unit and speedometer head assembly.

NOTE: If speedometer test fixture with master head is available, the speedometer can be tested with master speedometer reading 60 miles per hour. If speedometer calibration is not satisfactory when speedometer is driven mechanically, head may be recalibrated by an authorized United Motors Service Station. Speedometer calibration discrepancies have no connection with the electric drive unit, providing the speedometer head and motor unit are not binding, which is easily discovered by excessive pointer fluctuations.

STARTER SOLENOID

Starter solenoid is mounted on starter and solenoid plunger is connected to starter shift lever by a link (fig. 19). In addition to shifting starter pinion into engagement with flywheel ring gear, solenoid also completes circuit direct from battery to starter. Solenoid circuit is controlled by "STARTER" switch on switch panel in front of driver or on engine compartment panel, and a relay mounted in electrical compartment. Refer to "Engine Control and Generator Wiring Diagram" (MD-75606, MD-82893, or MD-83830).

Solenoid has two coils. The pulling coil draws comparatively heavy current for a short interval. This is needed to shift pinion into engagement with flywheel ring gear. The holding coil also aids the pulling coil. As soon as the shift is completed and the solenoid contacts complete the starter circuit,

the pulling coil is de-energized by action of the solenoid contacts and only the holding coil continues to draw current.

SOLENOID MAINTENANCE

Solenoid requires no maintenance other than keeping contact points and terminals clean and tight. Always check action of solenoid if it has been removed and reinstalled. If solenoid fails to function, first check switches, relays, and wiring before working on solenoid. Solenoid current draw can be tested, using suitable test equipment. Correct current draw values for solenoid is listed in "Specifications" at end of this group.

Battery

Two 12-volt batteries, connected parallel, are mounted in battery compartment located ahead of left rear wheelhouse. Two spring-loaded pull-type latch handles are located at bottom of door. To open door, pull latch handles outward and disengage from door; lift door to open position, disengage door prop from clip on door, and engage prop in bracket on body. To close door, raise door slightly and disengage prop from bracket on body, secure prop in clip on door, then lower door. Pull out on latch handles and engage catches at bottom of door.

The battery has three major functions to perform on the vehicle:

1. It provides a source of current for starting the engine.
2. It acts as a stabilizer to the voltage in the electrical system.
3. It can for a limited time furnish current when the electrical demands of the electrical equipment exceed the output of the generator.

BATTERY MAINTENANCE

Electrolyte level in the battery should be checked at least every 1,000 miles or once every two weeks. If the electrolyte level is found to be low, water should be added to each cell until the level rises to the bottom of the vent well. DO NOT OVERFILL! Distilled water or water passed through a "demineralizer" should be used to eliminate the possibility of harmful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life. DO NOT ADD ANY SUBSTANCE TO THE ELECTROLYTE EXCEPT WATER.

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down bolts should be kept properly tightened. For best results when cleaning battery, wash first with a dilute solution of ammonia or soda to neutralize any acid present, then flush off with clean water. Care must be used to keep vent plugs tight so that the neutralizing solution does not enter the cells. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder, but they should not be tightened sufficiently to place a strain on the battery case.

To insure good contact, the battery cable clamps should be tight on the battery posts. If the posts or cable clamps are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install clamps on battery posts and tighten firmly, then coat posts and clamps with petroleum jelly to help retard corrosion.

ON VEHICLE TESTS

Three battery checks are described below to determine in a minimum amount of time the condition of the battery.

1. State of Charge (Hydrometer Test).
2. Battery Capacity Test.
3. Three-Minute Battery Test.

If a battery failure is encountered the cause may lie outside the battery itself. DO NOT BE SATISFIED TO MERELY RECHARGE OR REPLACE IT. FIND THE CAUSE OF FAILURE AND PREVENT RECURRENCE OF TROUBLE.

STATE OF CHARGE (Hydrometer Test)

The hydrometer test is merely a means of determining the state of charge of the battery. This test will not necessarily indicate whether the battery is able to perform its normal functions, such as starting.

1. Measure specific gravity of electrolyte in each battery cell. The hydrometer tube must be held vertically. Do not draw too much electrolyte into the hydrometer. The float must be freely suspended in the electrolyte and the reading taken at

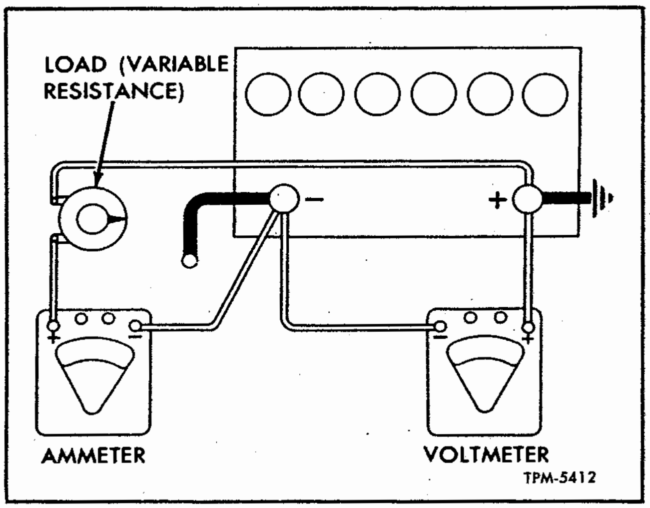


Figure 17—Battery Capacity Test (Typical Hook-Up)

eye level. If water has been recently added to the cells, or battery fast-charged, the hydrometer reading will be false.

2. Correct hydrometer reading for temperature. When electrolyte temperature is above 80 degrees F., add 4 points (.004) to reading for each 10 degrees above 80. If electrolyte temperature is below 80 degrees F., subtract 4 points for each 10 degrees below 80.

3.a. If the specific gravity readings are 1.215 - 1.270 at 80 degrees F., and variation between cells is less than 25 gravity points (.025), the battery presumably is at least 3/4 charged and in good condition for further use or testing of engine electrical circuits.

b. If the specific gravity readings are below 1.215 and the variation between cells is less than 25 gravity points, the battery presumably is in sound condition, but its state of charge is too low for further use or testing electrical circuits.

c. If the specific gravity readings show a variation between cells of more than 25 gravity points, an unsatisfactory battery condition is indicated which may be caused by shorted cells, acid loss, or a worn out battery.

To determine whether a battery is a good battery, regardless of its state of charge, proceed with the "Battery Capacity Test" below:

BATTERY CAPACITY TEST

This test is one means of determining whether a battery is functioning efficiently to the degree where it can be relied upon to perform all of its duties properly in the vehicle.

A 12-volt battery that will maintain 9.0 volts or better during a battery capacity test should be considered a good battery. To make this test, use equipment that will take a heavy electrical load to the battery such as a carbon pile or other suitable means. If test equipment is not available for loading battery, the starter may be used as a load. To prevent engine starting, place "ENGINE STOP" switch in engine compartment in "STOP" position.

1. Connect positive voltmeter and ammeter leads to battery positive post and negative voltmeter and ammeter leads to battery negative post (fig. 17). NOTE: Ammeter cable clips must contact battery posts; voltmeter cable clips must contact battery post or cable clamp, not the ammeter cable clips.

2. Apply a load to the battery of three times the ampere-hour rating of the battery for 15 seconds. Refer to "Specifications" at end of this group for ampere-hour rating of standard batteries used in vehicles covered by this manual.

3. With ammeter reading specified load, read voltage which should not be less than 9.0 volts.

a. If voltmeter shows 9.0 volts or more, battery has good output capacity and will readily accept a normal charge.

(1) If specific gravity is 1.215 or more, no service is required.

(2) If specific gravity is below 1.215, check charging circuit to determine the cause and correct as required. The battery should be slow-charged for city driving. With highway driving and a good charging system, the battery should charge satisfactorily.

b. If voltmeter shows less than 9.0 volts, proceed with the "Three-Minute Battery Test" described below:

THREE-MINUTE BATTERY TEST

In cases where a voltage of less than 9.0 volts is obtained in the "Battery Capacity Test" described above, an accurate test using a voltmeter and a fast charger will quickly establish in three to four minutes whether a battery is good or bad, even when the battery is in a discharged condition.

This procedure determines the condition of charged or discharged batteries by following the principles that:

a. A charged battery may be tested by taking current out of it.

b. A discharged battery may be tested by passing current through it.

THIS TEST SHOULD NOT BE USED IF BATTERY TEMPERATURE IS BELOW 60 DEGREES F.

If battery temperature is above 60 degrees F., add battery water, if necessary, and proceed with the three-minute battery test. CAUTION: Do not make this test, which is recommended for discharged batteries, if voltage obtained in "Battery Capacity Test" is 9.0 or more. A charged battery will not accept 40 amperes without an excessively high voltage.

Test Procedure

If voltage obtained in "Battery Capacity Test" was less than 9.0 volts, fast charge battery at 40 amperes for 3 minutes. Then, with charger still operating, test individual cell voltages of battery.

NOTE: If cell connectors are not exposed, it is necessary to pierce the cover to contact the connector straps to obtain individual cell voltages. Where pierced, the connectors should be resealed. A hot soldering iron may be used to reseal the connectors. DO NOT USE AN OPEN FLAME NEAR THE BATTERY.

a. If cell voltages are uneven by more than 0.1 volt, replace the battery.

b. If cell voltages are even within 0.1 volt, test total battery voltage with charger still operating on fast charge.

(1) If total voltage is over 15.5 volts, battery is unsatisfactory and is probably sulfated. Battery may be serviceable after continued slow charge; then test capacity. If above 9.0 volts, place back in service. If below 9.0 volts, replace the battery.

(2) If total voltage is under 15.5 volts, test specific gravity and charge battery.

OFF VEHICLE SERVICE

COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may lie outside the battery itself. For this reason, when a battery failure is encountered, do not be satisfied to merely recharge or replace it. Find the cause of the failure and prevent recurrence of the trouble. Listed below are some of the common causes of battery failure.

1. Defect in generating system such as high resistance, faulty generator or regulator.

2. Overloads caused by defective starter or excessive use of accessories.

3. Dirt and electrolyte on top of battery causing a constant drain.

4. Hardened battery plates, commonly called "sulfation," due to battery being in a low state of charge over a long period of time.

5. Physical defects such as shorted cells, loss of active material from plates, etc.

6. Driving conditions or requirements under which the vehicle is used only for short drives.

CHARGING

Batteries removed from the vehicle for charging should be charged continuously at a low rate until fully charged. Batteries may be safely slow-charged at a rate in amperes equal to 7% of the battery's ampere-hour capacity. (Refer to "Specifications" at end of this group for ampere-hour rating of standard batteries.) This is called the "normal" charge rate. The battery is fully charged when specific gravity readings taken at hourly intervals show no increase during three consecutive readings.

A very low rate -- not more than one-half the normal charging rate -- should be used for charging a sulfated battery. In the case of badly sulfated batteries, as much as 100 hours of charging time may be required before the battery becomes fully charged. Badly sulfated batteries may require a continuous slow charge for 48 hours or more before a rise in gravity reading occurs. If the specific gravity reading of any cell fails to reach 1.250 (corrected to 80°F.) or if there is a variation of more than 25 gravity points between cells after thorough slow charging, replace the battery.

Although the slow-charge method is recommended for charging all batteries, discharged batteries in otherwise good condition (refer to "Battery Capacity Test") may be given a boost with a quick charger if time does not permit complete slow charging. When using a quick charger, it must be remembered that the battery is only receiving a partial charge and that the battery electrolyte temperature must not be allowed to exceed 130°F. If the battery heats up excessively, quick charging must be discontinued.

BATTERY CABLES

Check cable leads and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces abnormal voltage drop which may lower voltage at starting motor to such a low value that normal operation of starting motor will not be obtained. Abnormal voltage drop can be detected with a low reading voltmeter as follows:

NOTE: To prevent engine starting, place "ENGINE STOP" switch in engine compartment in "STOP" position.

1. Check voltage drop between grounded (positive) battery terminal and vehicle frame. Place one prod of voltmeter on battery terminal and other on vehicle frame. With starting motor cranking engine at normal room temperature (70°F), voltage reading should be less than 0.3 volts. If more than this, there is excessive resistance in this circuit.

2. Check voltage drop between ungrounded (negative) battery terminal and starting motor terminal stud while motor is operated. If reading is more than one (1.0) volt, there is excessive resistance in circuit. NOTE: If necessary to extend wire from meter for this test, use No. 16 or larger wire.

3. Check voltage drop between starting motor housing and vehicle frame. This must be less than 0.1 volt.

Starting System

Starting system includes battery, starter, solenoid, solenoid relay, starter switches, circuit breaker, and wiring. Circuit is protected by No. 5 circuit breaker on panel at left of driver's seat and by No. 5 circuit breaker in electrical compartment. Starting system circuits are shown on "Engine Control and Generator Wiring Diagram" (MD-75606, MD-82893, or MD-83830). Refer to "WIRING AND MISCELLANEOUS ELECTRICAL" section for information on starter solenoid and relay.

OPERATION AND CONTROLS

Starting system operation is dependent upon the proper functioning of each unit included in the system. When starter switch is closed, an electrical circuit is completed through the starter relay winding which closes relay points. When points are closed, circuit is completed through windings in solenoid. Solenoid then functions to move starter pinion into mesh with flywheel ring gear, at which time contacts in solenoid complete circuit direct from battery to starter. Starter circuit is inoperative when "STARTER CUT-OUT" switch in engine compartment is in "OPEN" position.

STARTER DRIVE OPERATION

Pinion is shifted into mesh with the flywheel teeth by the action of the solenoid plunger when starter switch is held in "Start" position. Detailed action of the drive can be followed by referring to figure 18. Each illustration in figure 18 represents a position or step through which drive assembly passes in a complete cranking cycle.

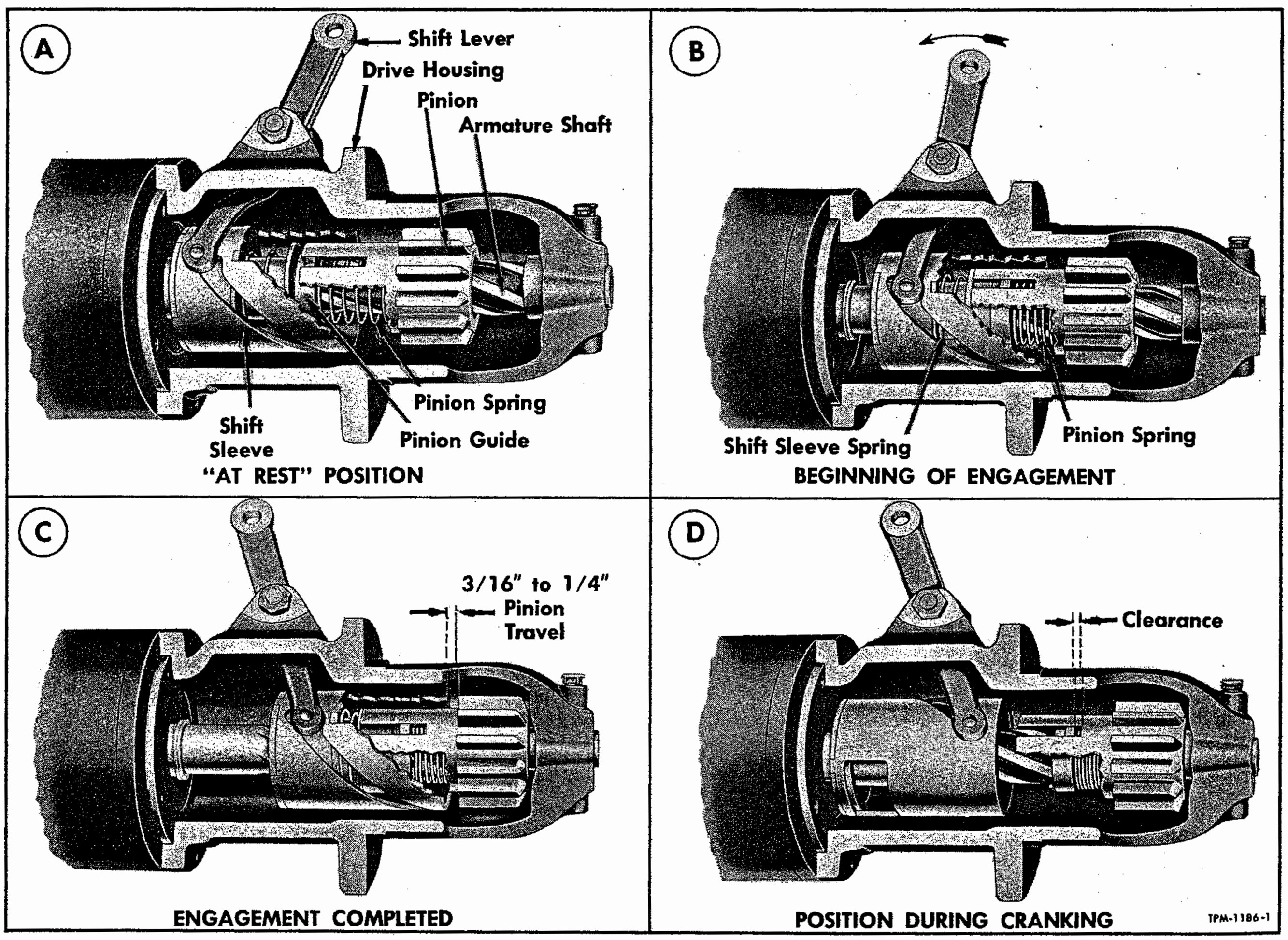


Figure 18—Dyer Drive Operating Positions

At Rest Position (View A - Fig. 18)

In the "at rest" position, pinion is held away from flywheel by locking action of pinion guide and pinion spring in milled portion of the shaft spline. The engine may or may not be in operation when drive is in this position. It is impossible for pinion to drift into flywheel when it is in this locked position.

Beginning of Engagement (View B, Fig. 18)

The engine is dead and the cranking operation has begun. As shift lever moves shift sleeve toward flywheel, pinion guide is unlocked from milled portion of spline by pressure of inner sleeve on guide. This action allows pinion to reach flywheel. Relative position of flywheel and pinion may be such that teeth will mesh immediately. If pinion teeth butt against flywheel teeth, pinion is further rotated until it reaches position for engagement. Compression of inner coil spring against pinion guide compensates for continued movement of shift lever and sleeve.

Engagement Action Completed (View C, Fig. 18)

When pinion has been rotated to proper position for engagement, action is completed by further movement of shift lever and by the action of the pinion spring. Pinion stop limits travel of pinion. When meshing of pinion with flywheel is completed, further movement of the solenoid plunger closes the switch contacts, completing the starter circuit.

Operating Position (View D, Fig. 18)

As starter begins to crank engine, shift sleeve is carried back to its original position by rotation of the armature shaft. When engine fires, accelerating action disengages pinion from flywheel and pinion returns to locked or "at rest" position.

It is impossible to start another cranking operation until complete cranking cycle is finished. After engine fires, shift lever should be allowed to return to "at rest" position; unit is then ready for another cranking operation.

It is impossible to engage pinion while engine is running, for as soon as pinion teeth touch moving flywheel teeth, shift sleeve is rotated and pinion follows armature shaft spline back to locked position.

Braking Action

The engagement action of shift lever is always against tension of shift lever return spring. When cranking operation is completed and shift lever returns, continued tension of shift lever return spring creates a force on armature toward commutator end of starter. This force is transmitted through armature brake directly against brake washer in commutator end frame. The force of the armature brake against brake washer stops armature almost immediately after shift lever is allowed to return. This feature makes starter immediately ready for another cranking operation in case engine does not continue to operate after it fires.

INSPECTION AND MAINTENANCE

Normal service may be obtained from starter with a minimum of trouble if regular lubrication, inspection, and maintenance procedures are followed.

CLEANING

Exterior as well as the interior of the starter should be kept clean. Use a clean cloth dampened with cleaning solvent to wipe off excess grease. Do not steam clean or dip starter, and avoid getting any water or cleaner in the starter. If interior of starter is dirty, remove, disassemble, and clean all parts individually.

COMMUTATOR

The cover band should be removed and commutator inspected at 5,000 mile intervals. If commutator is dirty, clean with strip of No. 00 sandpaper - DO NOT USE EMERY CLOTH. All dust must be blown from starter after commutator has been cleaned. Be sure band is secure after cleaning.

BRUSHES

Replace worn brushes. Brushes may be seated by use of a brush seating stone. With starter operating a medium speed, press stone firmly against commutator to cover area contacted by brushes. Brushes should seat satisfactorily in a short period. Blow starter out with compressed air after using stone to remove all particles of abrasive. Do not use emery cloth or sandpaper to seat brushes. Check brush lead connections to be sure they are tight.

Brush Spring Tension

Check brush spring tension. Excessive spring tension will cause commutator and brushes to wear rapidly. Low spring tension will cause a reduced starter speed, also arcing and burning of commutator and brushes. Replace springs if tension is not as listed in "Specifications" at end of this group.

MISCELLANEOUS

Make careful inspection of wires, terminals, and all visible parts of starter. Any apparent defects should be corrected immediately.

Unusual noises in the starter may be caused by loose mountings. Worn or dirty bushings may cause noise or slow starter speeds and require cleaning and lubrication or, if worn excessively, replacement. Improperly seating brushes may cause slow starter speeds. Brushes can be reseated as previously explained under "Brushes." Bent brush holders should be replaced.

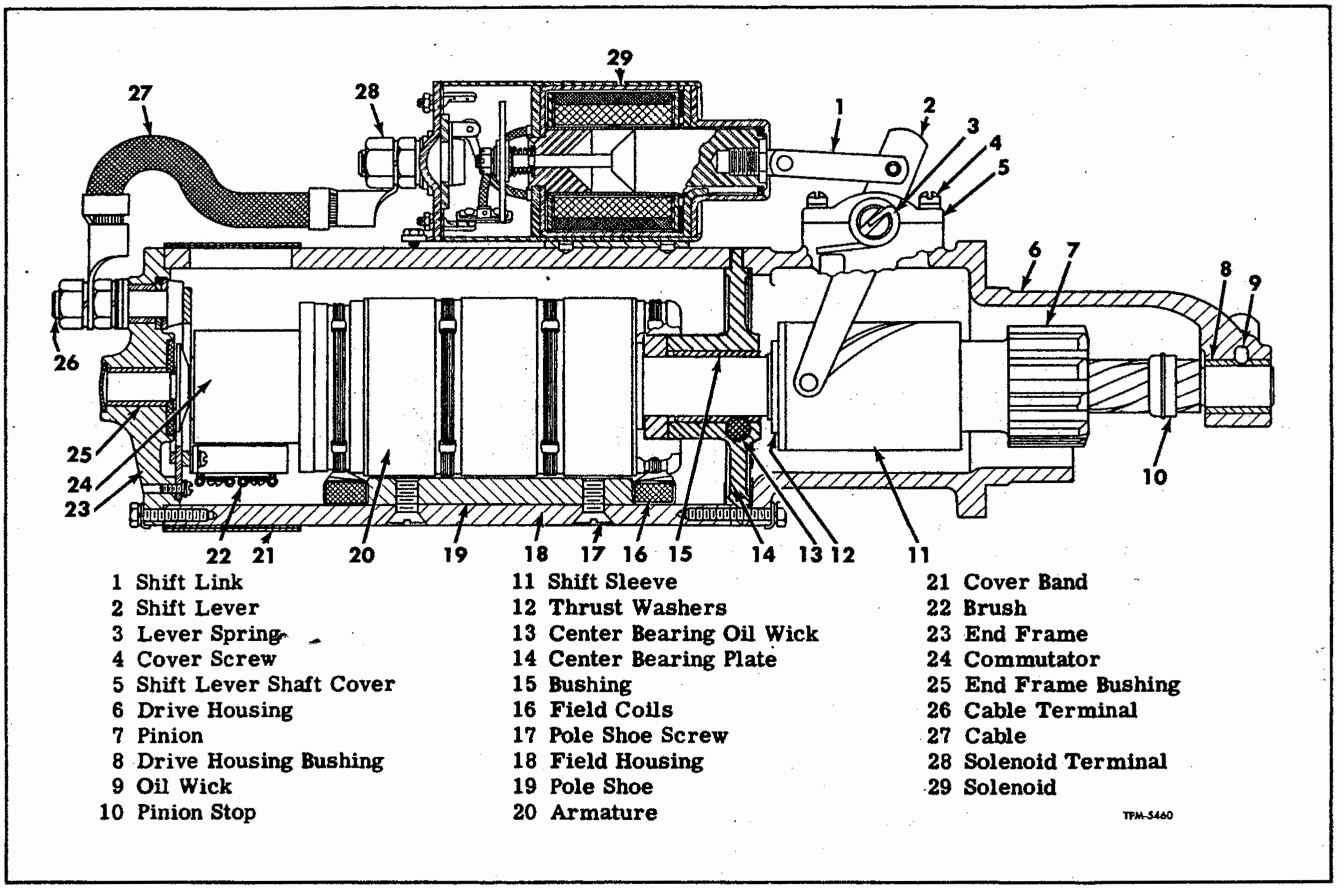


Figure 19—Starter and Solenoid Assembly

STARTER REMOVAL

1. Remove battery cable from solenoid "BAT" terminal and tape end to prevent accidental short and discharge of battery, or preferably disconnect ground cable at battery. Disconnect cables from small terminals on solenoid.

2. Remove three stud nuts attaching starter to flywheel housing. Move starter straight away from housing to complete removal.

STARTER DISASSEMBLY

(Refer to Figure 19)

1. Remove cable connecting solenoid terminal to terminal at starter commutator end frame. Disconnect solenoid plunger link from shift lever. Remove solenoid assembly from starter field frame.

2. Mark commutator end frame, field frame, center bearing plate, and drive housing to facilitate reassembling in correct position.

3. Remove cover band and disconnect the two field winding leads from brush holders.

4. Remove cap screws and lock clips attaching commutator end frame to field frame. Remove commutator end frame assembly.

5. Remove cap screws and lock clips attaching drive housing to field frame. Remove field frame from armature and drive housing.

6. Remove shift lever cover attaching screws. Remove cover, shift lever assembly, and shift lever spring. Remove drive housing from armature shaft.

7. Remove cotter pin attaching pinion stop to armature shaft, then remove stop. Remove Dyer Drive assembly from armature shaft, noting position of parts to aid in reassembly. Remove two washers, center bearing plate, and collar from armature shaft.

INSPECTION, TESTS, AND REPAIR

Wash all parts except field frame and field coil assembly and armature in cleaning solvent. Armature and field coils should be wiped clean with a dry rag. Tests described below may be made on a conventional growler equipped with test lamp and prods.

ARMATURE

Check armature to commutator leads to make sure they are properly soldered. Place one prod of test lamp on armature and other on commutator.

If test lamp lights, armature is grounded and should be replaced if defect is not readily apparent and reparable.

Place armature on growler. Hold hacksaw blade over armature and slowly rotate armature. If saw blade vibrates, armature is short circuited. Before replacing, inspect commutator slots for copper or brush dust deposits. Clean thoroughly and retest.

Burned commutator riser bars are sometimes caused by an open-circuited armature. If bars are not too badly burned, armature can sometimes be repaired by resoldering the leads in riser bar, using rosin flux solder. After soldering, turn down commutator and undercut the mica.

COMMUTATOR

Inspect commutator and if found to be rough, out-of-round, worn or has high mica, filled slots, or is burned, repair as follows:

Turning Down

Place armature in lathe and turn down commutator to remove worn spots, out-of-round, or rough condition. Do not cut deeper than necessary to clean up.

Undercut Mica

Mica between commutator segments must be below edges of segments. Start groove with a small three-cornered file; then use a hacksaw blade to undercut mica to a depth of 1/32". Use No. 00 sandpaper to clean and smooth up commutator, then blow all dust and cuttings out of grooves.

FIELD COILS

Place one test prod on field frame and touch other prod to each of the field coil leads which connect to the brush holder. The test lamp should light when each circuit is completed. If lamp does not light, field circuit is open. Inspect connections between coils.

Disconnect field coil leads from field frame at drive end. Pry leads away from frame to eliminate electrical contact. Place one test prod on field frame and other on each of the exposed leads. Lamp should not light. If lamp does light, field coils are grounded and must be replaced.

COMMUTATOR END FRAME

Remove all brushes. Place one test prod on end frame and other on brush holder and on terminal stud. Test lamp should not light. If test lamp does light, it is an indication of defective brush holder insulation or terminal insulators. Replace defective insulation under brush holders or at terminal.

If brushes are worn down to less than one-half their original length, they must be replaced. Be sure leads are secure in brushes and that clips are properly soldered to leads.

Check brush spring tension. If not within limits listed in "Specifications" at end of this group, replace with new springs. Examine hinge pins and brush holders for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

Replace end frame bushing if worn excessively or out-of-round.

DRIVE HOUSING

Replace bushing in drive housing if worn excessively or out-of-round. Also replace oil wick at bushing.

CENTER BEARING

If bushing in center bearing plate is worn excessively or out-of-round, replace. Also replace oil wick in center bearing plate.

DYER DRIVE

Carefully inspect all parts of "Dyer Drive" for wear or other damage. Check spring for weak or broken coils. Inspect pinion for worn or chipped teeth or splines.

STARTER ASSEMBLY

1. Install commutator end frame on field frame, aligning marks made prior to disassembly. Attach with cap screws and lock clips.

2. Insert armature into field frame, with end of shaft inserted in bushing in end frame.

3. Place collar and center bearing plate over drive end of armature shaft and position center bearing plate against field frame, aligning marks made prior to disassembly.

4. Place plain washer and cupped washer over armature shaft, with cupped side of washer toward armature shaft. Assemble shift sleeve, pinion guide, and spring on armature shaft, with lugs on pinion guide away from end of shaft and with large end of spring toward end of shaft (fig. 20). Do not twist the pinion guide into shaft more than about 1-3/4" from end of shaft. Hold guide in this position and place pinion on shaft over spring, compressing spring into pinion skirt. Align lugs on pinion guide with slots in pinion skirt. Hold pinion guide stationary with thumb and forefinger while pushing pinion onto shaft so lugs on guide enter slots in pinion skirt. Remove thumb and forefinger and twist the assembly back onto the armature shaft and into the shift sleeve. As it reaches the extreme position, a click will be heard which indicates that the pinion guide has dropped into the undercut section of the shaft splines so the assembly is locked in the "at rest" position.

5. Install pinion stop by aligning it with the spline grooves and turning it on until it hits the

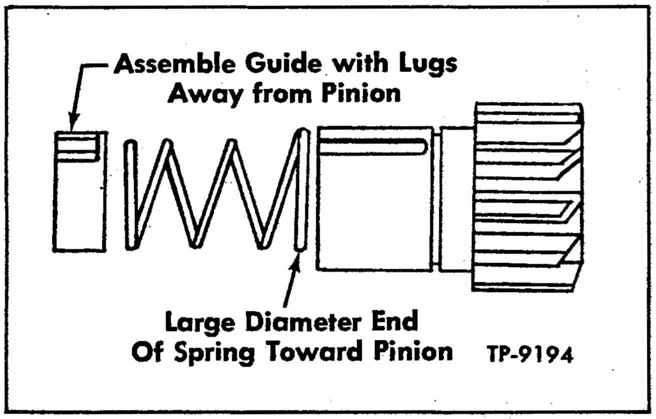


Figure 20—Position of Drive Pinion and Pinion Spring

undercut. It can then be rotated to align the holes in the shaft and pinion stop. Install new cotter pin to hold pinion stop in place. Lubricate the drive after assembly with a few drops of light engine oil. Do not use heavy oil or grease.

6. Install drive housing over drive assembly and armature shaft and position against center bearing plate. Attach drive housing and center bearing plate to field frame with cap screws and lock clips.

7. Assemble shift lever and cover to drive housing, being sure end of lever is in the spiral slot in shift sleeve. Attach cover to drive housing with screws and lock washers and tighten firmly. Check action of lever. If any binding is evident, it can be corrected by tapping cover with soft hammer to align it with shaft and housing. Place shift lever spring on shaft with long tang on boss on drive housing. Twist coiled end of spring and drop into slot in end of shaft.

8. Install solenoid on field frame and connect plunger link to shift lever. Install cable connecting solenoid and commutator end frame terminals.

9. Adjust linkage between solenoid and shift lever as directed below.

SOLENOID AND DRIVE ADJUSTMENT

When shift lever is in extreme forward position and switch contacts in solenoid are closed, it should be possible to push the pinion back against spring pressure 3/16" to 1/4" (D, fig. 18). This adjustment can be checked easily by disconnecting cable from solenoid to starter terminal and using battery current through solenoid to hold shift lever in forward position. Since disconnecting this cable opens pull-in coil circuit of the solenoid, it may be necessary to assist movement of plunger by hand to assure that plunger will reach its extreme travel position, closing switch contacts. The starter armature will not revolve with this cable disconnected. The pinion travel can be checked by pushing pinion back against spring pressure. The adjustment can be changed by turning plunger stud in or out of solenoid.

A test can be made to determine if engagement action is being completed before switch contacts are closed. This can be done by placing a 9/16" spacer between pinion and pinion stop. The shift lever can then be moved forward, forcing pinion against spacer. It should not be possible to close switch contacts with spacer in place. This adjustment can be changed by adjusting plunger stud as mentioned above.

When pinion is in engaged position (E, fig. 18), there should be 1/32" clearance between pinion guide lug and bottom of slot in pinion skirt. If there is not clearance at this point, drive will be taken directly from lugs on pinion guide rather than from the heavy spline in the pinion. If there is no clearance at this point, pinion and pinion guide should be replaced. The pinion, with its lock and lock spring, is released by moving pinion shift sleeve forward along shaft splines.

When assembling drive parts, pinion guide lugs must be away from the pinion (fig. 20) or it will not be in the proper position to lock on the shaft.

If testing equipment is available, No-Load and Torque tests may be made to determine if starter operates properly. Data necessary for these tests is listed under "Specifications" at end of this group.

INSTALLATION

1. Locate starter in position against flywheel housing. Install three stud nuts, using lock washers. Tighten nuts evenly and alternately until tight.

2. Attach battery and solenoid cables to starter solenoid, then tighten terminal nuts.

Generator

Generator (fig. 22) is a heavy-duty, six-brush, shunt type unit with special interpole windings in series with the insulated brushes and armature terminal. Interpole windings improve commutation and make possible a higher output. Maximum output is possible at moderate armature speeds because of the high field current, which is approximately three times greater than in ordinary heavy-duty generators.

The armature shaft is supported by a roller bearing in the drive end frame and by a shielded ball bearing in the commutator end frame. Brush holders are of one-piece construction and are mounted on the commutator end frame. Insulated brush holders are electrically insulated from the end frame. Each brush holder is held in place by two countersunk screws extending through the end frame. Special two piece brushes of laminated construction are used.

Air entering generator passes through an oil-wetted mesh type air cleaner which is mounted on the commutator end frame. Air passes through generator and is drawn into the engine air intake duct through a hose connected to an opening in the drive end frame. Refer to FUEL SYSTEM (SEC. 12) for illustration showing air outlet hose installation.

GENERATOR MOUNTING AND DRIVE

Generator is mounted on engine gear train cover and is driven from the engine balance shaft through a step-up gear arrangement as shown in figure 21. Spacer ring, installed between generator and gear train cover, provides a means of controlling the position of the generator driven gear. This control is affected by the three tapered-end socket-head set screws which locate the spacer ring on the gear train cover. External teeth on small driven gear on generator armature shaft mesh with internal teeth in the larger drive gear, thus driving the armature shaft faster than the engine balance shaft. Gear ratio is 1.72 to 1.

INSPECTION AND REPAIR

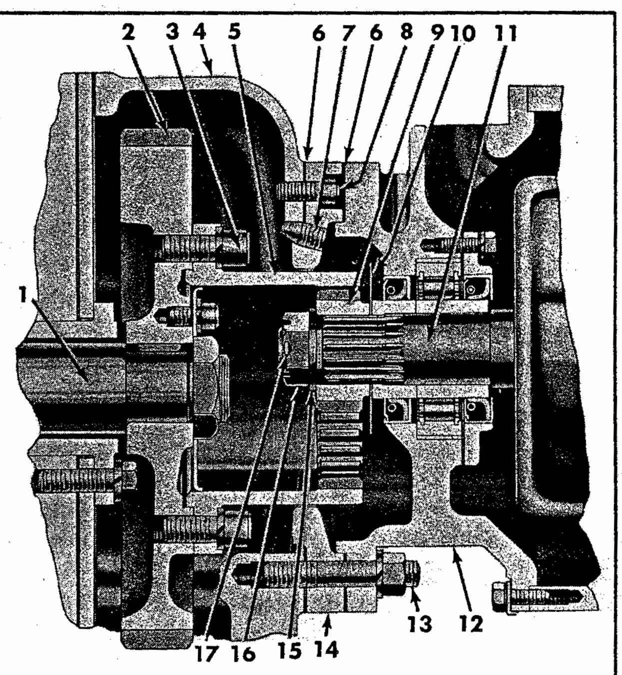
Normal service may be obtained from generator with a minimum of trouble if regular inspection and maintenance procedures are followed.

LUBRICATION

Roller bearing at drive end and ball bearing at commutator end are lubricated through grease cups. Air cleaner must be cleaned regularly. Refer to LUBRICATION (SEC. 13) for lubrication and air cleaner service instructions.

CLEANING

Exterior as well as interior of the generator assembly should be kept clean. Use a clean cloth dampened with cleaning solvent to wipe off excess grease. Do not steam clean or dip generator into a cleaning solvent. Avoid getting any water or cleaning solvent in generator. If interior is dirty, remove and disassemble generator and clean individual parts. Use only cleaning solvents derived from petroleum such as kerosene or gasoline. Never use chemical solvent or alkalies since these may damage the insulation.



1 Engine Balance Shaft
2 Balance Shaft Gear
3 Socket-Head Set Screw
4 Engine Gear Train Cover
5 Internal-Toothed Drive Gear
6 Gaskets
7 Tapered-End Socket-Head Set Screw
8 Socket-Head Set Screw
9 External-Toothed Driven Gear
10 Oil Slinger
11 Armature Shaft
12 Generator Commutator End Frame
13 Generator Mounting Stud
14 Spacer Ring
15 Flat Washer
16 Nut
17 Cotter Pin

TP-9196

Figure 21—Generator Mounting and Drive

COMMUTATOR

The cover band should be removed and commutator inspected at 5,000 mile intervals. If commutator is dirty, clean with a strip of No. 00 sandpaper. Do not use emery cloth. Blow all dust out of generator after cleaning commutator.

BRUSHES

Check the surface of the brushes making contact with commutator to make sure they are seating properly. Brushes can be seated with a brush seating stone. Do not use emery cloth or sandpaper for seating brushes. With generator operating at medium speed, press seating stone firmly against commutator to cover the area contacted by brushes. Brushes should seat satisfactorily in a short time. Blow out all particles of abrasive and dust after seating brushes. Excessively worn brushes should be replaced and new brushes should be seated.

NOTE: After new brushes have been installed and seated, generator neutral point must be adjusted as directed later in this section under "Generator Assembly."

Brush Spring Tension

Check brush spring tension with a spring scale. Replace springs if tension is not within limits listed in "Specifications" at end of this section. Excessive spring tension will cause rapid brush and commutator wear. Low spring tension will result in reduced generator output, also arcing and burning of commutator and brushes.

MISCELLANEOUS

Make a thorough inspection of wires, terminals, and all visible parts of generator. Any apparent defects should be corrected immediately. A poor connection in charging circuit will cause generator to build up excessive voltage which may result in burned field or armature windings. A poor connection in field circuit will result in low generator output.

Noise in generator may be caused by loose mounting, worn drive gears, worn or dirty bearings. Dirty bearings should be removed, cleaned, and lubricated. Improperly seating brushes or bent brush holders may also cause noise. Seat brushes or replace holders as necessary.

GENERATOR REPLACEMENT

REMOVAL (Fig. 21)

1. Disconnect wires and cable from generator terminals. Tag wires for identification at time of installation.
2. Disconnect air outlet hose from air outlet fitting on generator drive end frame.
3. Remove nuts and lock washers from five mounting studs. Pull generator straight back off mounting studs to complete removal.
4. If a new or rebuilt generator assembly is to be installed, remove driven gear, air outlet fitting, and air cleaner for installation on replacement unit.

INSTALLATION (Fig. 21)

1. Before installing generator, inspect drive gear for worn or damaged teeth. If wear or damage is evident, drive gear must be replaced as follows:
   a. Remove three socket-head screws attaching spacer ring to gear train cover. Remove spacer ring and gasket.
   b. Remove six socket-head screws and lock washers attaching drive gear to balance shaft gear. Remove drive gear.
   c. Position drive gear on balance shaft gear, with pilot on drive gear entering bore in balance shaft gear. Install six socket-head screws, with lock washers, and tighten firmly.
   d. Place gasket and spacer ring over generator mounting studs. Tapered ends of set screws must enter bore in gear train cover. Attach ring to gear train cover with three socket-head screws. Tighten screws snugly.
   e. Clamp a dial indicator to drive gear in such a manner that the indicator pin will contact the generator end frame pilot bore in spacer ring. Turn engine over with starter and note reading on dial indicator. Pilot bore in spacer ring must be concentric with drive gear within 0.002" total indicator reading. Adjust tapered set screws, if necessary, to locate spacer ring within limits. After proper concentricity is obtained, tighten attaching screws to 8-12 inch-pounds.
2. Install oil slinger and external toothed driven gear on armature shaft and secure with flat washer, nut, and cotter pin. Install air outlet fitting and gasket on generator drive end frame. Install air cleaner on generator commutator end frame.
3. Place gasket over generator mounting studs. Position generator assembly at engine, with holes in end frame flange over mounting studs and with teeth on driven gear engaging teeth in drive gear. Install lock washers and nuts on five mounting studs, and tighten firmly.
4. Connect cable to generator "A" terminal, and connect wires to "F" and "GRD" terminals according to identification made at time of removal. Tighten terminal nuts firmly.
5. Connect air outlet hose to outlet fitting on generator. Tighten hose clamp firmly. Lubricate generator as directed in LUBRICATION (SEC. 13).
6. IMPORTANT: Before starting the engine, polarize generator as directed under "Polarity" in "REGULATOR" section.

TESTING GENERATOR

If improperly functioning generator has been removed from the engine due to one of the symptoms

listed below, accomplish the applicable test procedure to locate the source of trouble before disassembling generator.

NO OUTPUT

Remove cover band and check for sticking or worn brushes and burned commutator bars. Burned bars, with other bars fairly clean, indicate open circuited coils. If brushes are making good contact with commutator, and commutator looks satisfactory, test as follows, using conventional test light:

1. To test for grounded armature, raise grounded brushes and insulate from commutator. Check with test leads from "A" terminal to generator field frame. Lamp should not light. If lamp does light, raise other brushes and check "A" terminal and commutator separately to locate ground. A ground in an interpole winding will cause "A" terminal to appear grounded, since the interpole windings are in series with the "A" terminal and insulated brushes. When such a ground is indicated, the interpole coils must be checked individually to locate the trouble.

2. Test for open field circuit with test leads on "F" and "GRD" terminals. If test lamp fails to light, field is open circuited. After disassembly, field coils can be separated and tested individually to locate the defective coil.

3. If field circuit is not open, check for shorted or grounded field by measuring field current draw. Excessive current draw will indicate shorted or grounded field. Check current draw by applying exactly 12 volts across field at 80°F. and measuring current draw with an ammeter. Current draw should not exceed limits listed in "Specifications" at end of this group. If field is shorted or grounded, it is necessary to disassemble generator to locate the defective field.

4. An open circuit in the armature is usually evident, as this condition usually causes burned armature bars.

5. If trouble has not yet been located, disassemble generator and test armature for short circuit on a growler as described under "Testing Parts" later in this section.

EXCESSIVE OUTPUT

If regulator is known to be operating satisfactorily, excessive output may result from a shorted generator field. This can be checked as described in step 3 under "No Output" above.

UNSTEADY OR LOW OUTPUT

Unsteady or low generator output may be the result of any one or more of the following conditions:

1. Sticking brushes, low brush spring tension, dirty commutator, or other conditions which prevent good contact between brushes and commutator. Correct as previously directed in this section under "Inspection and Maintenance."

2. Inspect commutator for roughness, grease, dirt in slots, high mica, out-of-round, or burned bars. If any of these conditions are evident, generator must be disassembled and commutator turned down as directed later under "Inspection, Tests, and Repair." If bars are burned, an open circuit is indicated. This condition must be corrected, if possible, or the armature replaced.

GENERATOR DISASSEMBLY

1. Mark field frame, commutator end frame, and drive end frame prior to disassembly to facilitate assembling in same relative position. Remove four wing nuts attaching air cleaner cover to bearing end plate. Remove cover and air cleaner.

2. Remove cover band from commutator end frame. Disconnect interpole coil lead from insulated brush holder connector.

3. Remove screws and lock washers attaching bearing end plate to commutator end frame. Remove cotter pin, nut, and washer from commutator end of armature shaft.

4. Remove cap screws and lock clips attaching commutator end frame to field frame. If necessary tap end frame with soft hammer to loosen from field frame, then remove end frame assembly. Remove snap ring securing ball bearing in end frame sleeve, then press bearing assembly out of sleeve. Disconnect brush leads and brush holder connector from brush holders. Remove brushes and connector.

5. If driven gear is on shaft, remove cotter pin, nut, and flat washer, then pull gear off shaft. Remove cap screws and lock clips attaching drive end frame to field frame. If necessary, tap end frame with soft hammer to loosen from field frame, then remove end frame assembly from armature shaft. Remove field frame from armature.

6. Remove air outlet fitting and gasket from drive end frame. Remove cap screws and lock washers attaching bearing retainer plate to drive end frame. Remove retainer plate and gasket. Remove roller bearing from drive end frame.

7. It is not necessary to remove pole shoes, field coils, and interpole coils from field frame unless replacement is necessary as indicated later under "Inspection, Tests, and Repair."

INSPECTION, TESTS, AND REPAIR

All parts except field coils, interpole coils, and armature should be washed in cleaning solvent. Field coils, interpole coils, and armature should be wiped clean with a dry rag. Tests described below may be made on a conventional growler equipped with a test lamp and prods.

GENERATOR

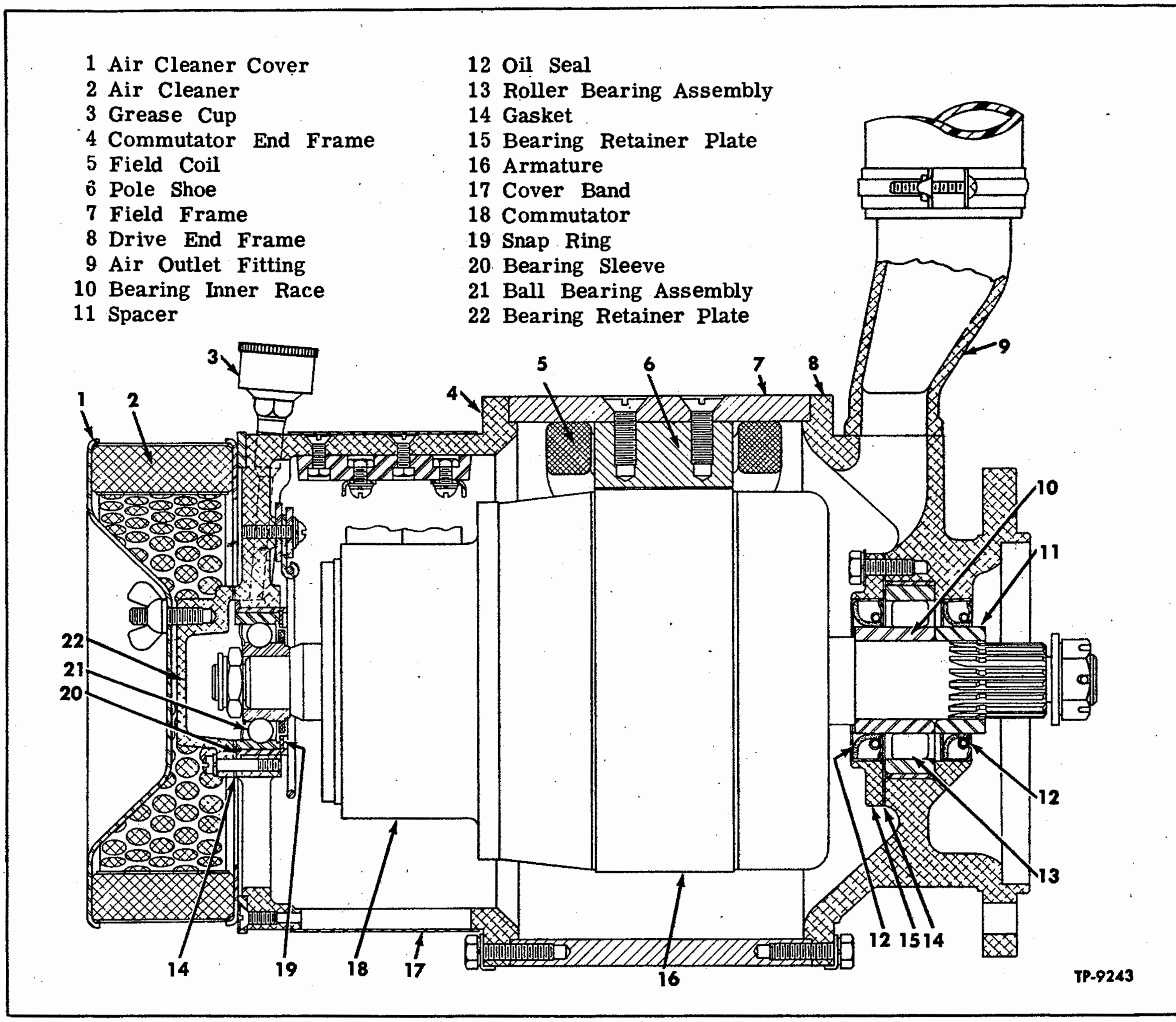


Figure 22—Generator and Air Cleaner

ARMATURE

Check armature to commutator leads to make sure they are properly soldered. Place one test prod on armature and the other on commutator. If lamp lights, armature is grounded and should be replaced if defect is not readily apparent and reparable.

Place armature on growler. Hold hacksaw blade over armature and slowly rotate armature. If saw blade vibrates, armature is short circuited. Before replacing, inspect commutator slots for copper or brush dust deposits. Clean slots thoroughly and retest.

Burned commutator riser bars are sometimes caused by an open-circuited armature. If bars are not too badly burned, armature can sometimes be repaired by resoldering the leads to the riser bars, using rosin flux solder. After soldering, turn down the commutator and under-cut the mica as directed later under "Commutator."

Inspect drive end bearing inner races on drive end of armature shaft. If wear is evident, pull races off shaft and press new races onto shaft. Radius on inner race must be next to shoulder on shaft.

COMMUTATOR

Inspect commutator and if found to be rough, out-of-round, worn or has high mica, filled slots, or is burned, repair as directed below.

Turning Down

Place armature in lathe and turn down commutator to remove worn spots, out-of-round, or

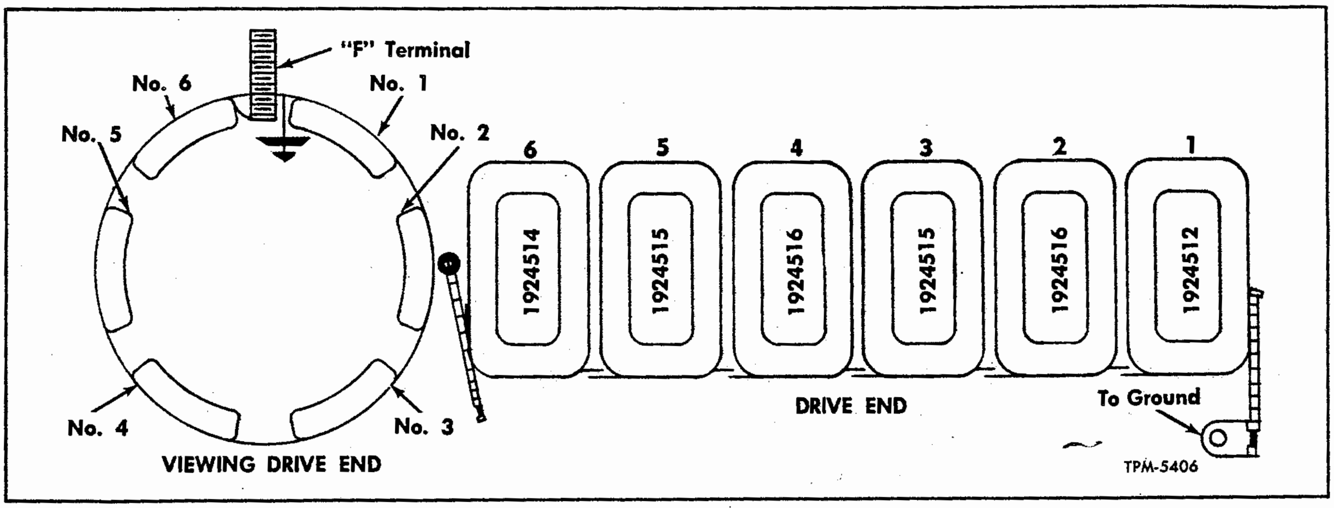


Figure 23—Field Coil Locations

rough condition. Do not cut deeper than necessary to clean up. Commutator must not be more than 0.001" out of round after turning down.

Undercut Mica

Mica between commutator segments must be below edges of segments. Start groove with a small three-cornered file, then use a hacksaw blade to undercut mica to a depth of 1/32". Use No. 00 sandpaper to clean and smooth up commutator, then blow out all particles of dust and cuttings.

FIELD COILS

These tests must be made with field coils installed in field frame.

1. Place one test prod on "F" terminal and the other on field frame. Lamp should light. If lamp does not light, field coils are open circuited.

2. Disconnect field coil lead from field frame. Place one test prod on "F" terminal and the other on field frame. Lamp should not light. If lamp does light, field coils are grounded.

3. If field current draw was excessive as indicated under "No Output" in "Testing Generator," determine which coil is grounded as follows: Remove insulation from soldered connections between coils, then check current draw of each coil separately. The coil which draws the most current is shorted and must be replaced.

4. If ground or open circuit is indicated in tests 1 and 2 above, break the connections between the coils and test each coil separately to determine which one is defective.

5. If field coil insulation is cracked, charred, or worn so that windings are exposed, coils should be reinsulated or replaced. When replacing field coils, refer to figure 23 for correct location of coils. Part numbers shown are stamped on the coils. Connect and reinsulate any field coil connections which have been broken or bared during tests.

INTERPOLE COILS

1. Place one test prod on interpole coil lead which was disconnected from brush holder connector and the other on "A" terminal. Lamp should light. If lamp does not light, coils are open-circuited and must be repaired or replaced.

2. Make sure interpole coil lead is not touching field frame. Place one test prod on "A" terminal and the other on field frame. Lamp should not light. If lamp does light, coils or "A" terminal stud are grounded. Disconnect lead from "A" terminal and test terminal stud and interpole coils separately to locate the ground. Replace "A" terminal stud insulation or replace interpole coils as necessary.

BRUSHES, HOLDERS, AND SPRINGS

1. Check insulated brush holders by placing one test prod on insulated brush holder connector and the other on end frame. Lamp should not light. If lamp does light, remove brush holder connector and test each insulated brush holder separately to determine which one is grounded. Replace insulating washers, bushings, or brush holder assemblies as necessary to correct the grounded condition.

2. If brushes are worn down to less than one-half their original length, they must be replaced. Make sure leads are secure in brushes and that clips are properly soldered to leads.

3. Check brush spring tension with a spring scale. Replace springs if not within limits listed in "Specifications" at end of this group. Examine brush holders for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

BEARINGS

Thoroughly clean bearings and inspect for worn or damaged balls, rollers, or races. Pack bearings with grease recommended in LUBRICATION (SEC. 13).

GENERATOR

OIL SEALS

Examine lips of oil seals in drive end frame and in drive end bearing retainer plate for evidence of wear or deterioration. Replace seals if not in good condition.

GENERATOR ASSEMBLY
(Refer to Figure 22)

1. If seals were removed from drive end frame and bearing retainer plate, install seals so that spring loaded lips will point toward drive end of armature shaft. Install drive end bearing and outer race assembly in drive endframe. Make sure all brush holders and springs are installed in commutator end frame. Install snap ring in groove in bearing sleeve in commutator end frame, then press ball bearing into sleeve until it seats against the snap ring. Sealed side of bearing must be toward snap ring end of sleeve.

2. Place drive end bearing retainer plate and seal assembly on inner side of drive end frame, using new gasket between retainer and end frame. Attach retainer plate to end frame with six screws, lock washers, and flat washers. Tighten screws firmly.

3. Mount field frame assembly in horizontal position in vise. Do not tighten vise sufficiently to distort frame. Install armature in field frame. Place drive end frame assembly over drive end of armature shaft and against field frame, with marks made prior to disassembly aligned. Attach end frame to field frame with ten cap screws and lock clips.

4. Install commutator end frame and bearing assembly over end of armature shaft and position against field frame, with marks made prior to disassembly aligned. Attach end frame to field frame with six cap screws and lock clips. Tighten screws only finger-tight.

5. Install washer and nut on commutator end of armature shaft, tighten nut to 60-65 foot-pounds torque, and secure nut with cotter pin. Pack cavity in ball bearing retainer plate with lubricant, then install plate on end frame, with new gasket between plate and end frame. Insert screws through end plate and thread into end frame. Tighten screws firmly.

6. Install brushes in brush holders and connect brush leads, making sure connections are tight. Connect lead from "A" terminal to insulated brush holder connector.

7. Before installing generator on vehicle, adjust neutral point as directed below, then test generator as previously directed.

NEUTRAL POINT ADJUSTMENT

Whenever generator has been disassembled, new brushes, armature, or field coils installed, the neutral point must be adjusted. The neutral point refers to a particular relationship between the field poles, armature windings, and brushes. When the relationship of these parts is correct, minimum arcing and best commutation and brush life will be obtained. All brushes must be properly seated with a brush seating stone before adjusting neutral point.

CAUTION: Adjustment for neutral point must be made as quickly as possible since armature will begin to heat. Do not allow armature to overheat. Adjust as follows:

1. With generator assembled and commutator end frame attaching screws just tight enough to hold end frame in place, place generator on test bench with armature free to rotate, and without any connection to generator field (F) terminal.

2. Connect a battery between generator armature (A) terminal and ground, and allow a current of approximately 100 amperes to flow through armature. (Current may be controlled by variable resistance or by varying the number of battery cells used.)

3. Note tendency of armature to rotate. The neutral point is found by shifting (rotating) commutator end frame into the position at which there is no tendency for the armature to turn in either direction. Tighten commutator end frame attaching cap screws firmly and secure with lock clips.

Regulator

The regulator shown in figure 24 is a heavy-duty carbon pile regulator developed especially for use with light-weight, high-output generators. Although similar in external appearance to other heavy-duty regulators of the vibrating-contact type, the carbon pile regulator functions on an entirely different principle which must be clearly understood before adjustments are attempted. Both types of regulators serve the same purpose, namely, to limit voltage and current to the required operating values, and to disconnect the generator from the battery when the generator is not capable of supplying power to the system, but the methods of control are basically different.

CONSTRUCTION AND OPERATION

In the carbon pile regulator, the field current is controlled by a carbon pile rheostat inserted in the field circuit. The field circuit is not interrupted, and any amount of field current can be handled provided the unit is made large enough and has sufficient heat-dissipating capacity. To dissipate the heat generated in the rheostat by its continuous operation, the aluminum castings of the current and voltage regulators, which hold the carbon disks, are attached directly to a radiator which carries the heat outside the box.

The carbon pile rheostat itself consists of a stack or pile of small flat carbon disks inside a ceramic tube. Resistance of the stack varies with the amount of pressure on the disks, decreasing as the pressure is increased. The carbon disks must be absolutely flat and free of any foreign material, especially grease and dirt. This is necessary to reduce the change in length of the carbon pile in relation to the required changes in pressure. Throughout the working range of the regulator the change in length of the carbon pile does not exceed 0.003".

CURRENT AND VOLTAGE REGULATORS

In order to control the generator, the resistance of the rheostat must be made to vary with every change in load or speed. This is accomplished by the current and voltage regulators in which the carbon disks are compressed by a spring and the spring opposed by an electromagnet. The electromagnet in the voltage regulator (fig. 25) is wound with many turns of fine wire and is connected in shunt across the generator. In the current regulator (fig. 25) the electromagnet is wound with a few turns of heavy wire and connected in series with the generator output. When the voltage or the current tends to exceed the adjusted value, the increased pull of the electromagnet reduces the pressure on the disks, thus increasing their resistance and reducing the voltage or current, depending on which regulator is called upon to function. Under a steady condition of speed and load, the regulator assumes the position required to furnish the proper resistance and remains static as long as this condition persists. This characteristic tends to prolong the useful life of the carbon pile regulator.

The very small change in length of the carbon pile in operation is necessary to prevent uneven operation which might otherwise result from overcontrol. It is also necessary to use a special spring which closely matches the pull of the electromagnet over the whole range of movement. Both the voltage and current regulators are electrically dampened to reduce the effect of sudden surges of voltage or current.

The dampening is accomplished in the voltage regulator by connecting a stabilizing resistor between the voltage control circuit and the field circuit (fig. 25). Whenever a sudden increase of voltage occurs, a greater part is absorbed or bypassed by the resistance, permitting little change in the shunt winding and to the carbon stack. The resistance for the current regulator is a calibrated by-pass lead connected across the series winding and it is capable of carrying a relatively large percentage of the charging current. Whenever a sudden change in current occurs the bulk of the current is by-passed through the calibrated lead

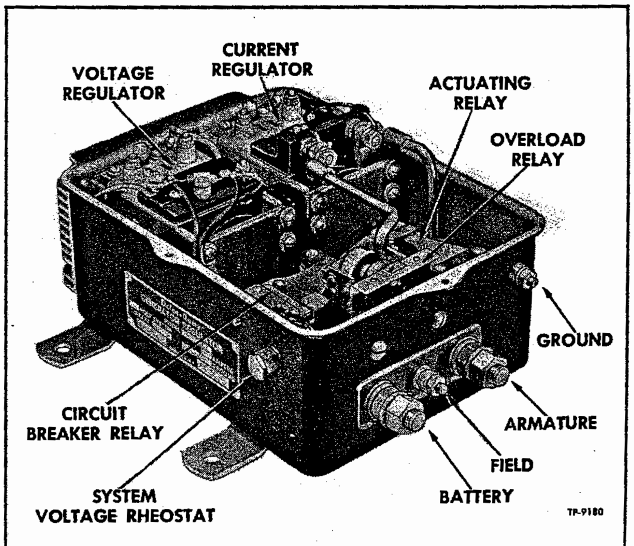


Figure 24—Carbon Pile Regulator

REGULATOR

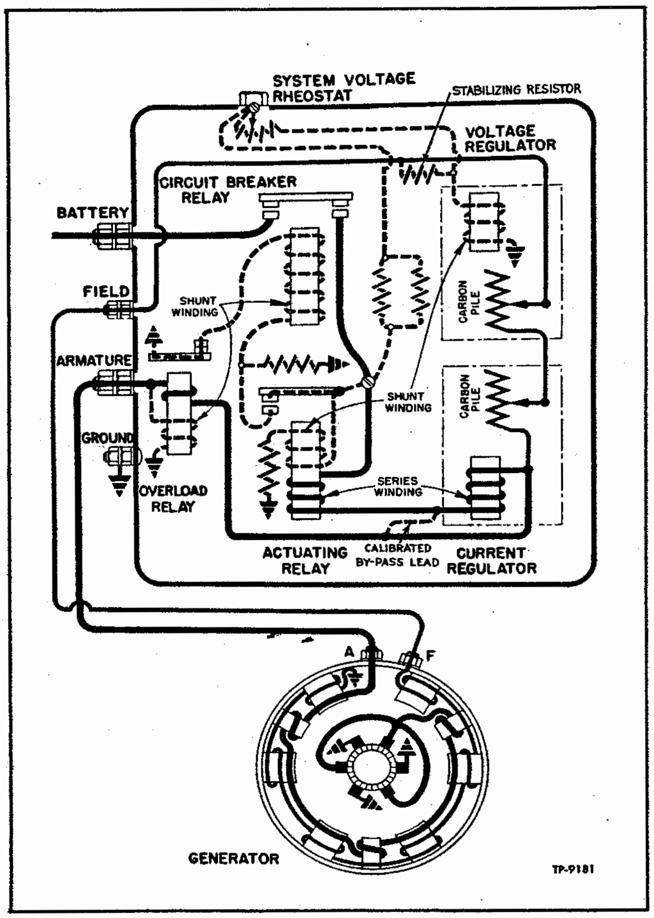


Figure 25—Generator—Regulator Wiring Diagram

and little or no effect is noted in the series winding and to the carbon stack. This by-passing action results from the inductive characteristics of the current regulator series winding repelling the sudden increase in current.

SYSTEM VOLTAGE RHEOSTAT

In addition to the current and voltage regulators, which operate as described, a small rheostat is included in the control portion of the regulator. This rheostat, called the system voltage rheostat, is connected in series with the coil of the electromagnet in the voltage regulator and a pair of paralleled fixed resistors. By changing this variable resistance, the voltage setting of the regulator can be raised or lowered within a small range (approximately 3 volts).

The system voltage rheostat is mounted on the wall of the box so that it can be adjusted from the outside. This offers a ready means of correcting the system voltage (within limits) without removing the cover of the generator-regulator or changing mechanical adjustments of the units. (The adjusting screw is protected by a hex head plug that should be replaced after adjustment.)

ACTUATING, CIRCUIT BREAKER, AND OVERLOAD RELAYS

The remainder of the regulator is made up of the actuating and circuit breaker relays and the special reverse current overload relay. Each of these relays performs a different function and it is important that their operation be understood. Generally speaking, the actuating and circuit breaker relays act together to open and close the battery circuit in accordance with generator voltage, while the reverse current overload relay prevents excessive reverse currents. Details of these operations are covered in the following paragraphs.

The actuating relay contains two windings and one set of contact points. One of the windings is a series winding of a few turns of heavy wire (shown in fig. 25) which is part of the charging circuit. The second winding is a shunt winding consisting of many turns of fine wire (shown in dashed lines in fig. 25) which, in series with a resistor, is shunted across the generator. When the generator is not operating, the actuating relay contact points are held open by the tension of a spiral spring. The circuit breaker relay (fig. 24) contains a shunt winding (shown in dashed lines in fig. 25) on a core, above which is an armature with two heavy contact points. Beneath these points are two stationary contact points, one of which is connected through the actuating relay and current regulator series windings to the "ARMATURE" terminal and thence to the insulated terminal of the generator. The other is connected directly to the regulator "BATTERY" terminal and thence to the battery through the wiring circuit. The contact points are held open by the tension of a spiral spring when the generator is not operating.

When the generator begins to operate, a magnetic field is built up by the actuating relay shunt winding. When generator voltage reaches the value for which the relay is adjusted, the magnetic field is sufficiently strong to pull the armature down toward the core, causing the contact points to close. Closing of the contact points connects the circuit breaker relay shunt winding across the generator. This creates a strong magnetic field which pulls the circuit breaker relay armature down so that the contact points close and complete the circuit between the generator and battery. Charging current then flows in the series winding of the actuating relay, building up an additional magnetic field which assists the field of the shunt winding in holding the armature down.

When the generator voltage drops below battery voltage, current flows from the battery to the generator. This reverses the flow of current through the actuating relay series winding. As a result, the magnetic fields of the series winding and the shunt winding no longer assist each other, but become magnetically opposed. The resultant magnetic field

becomes too weak to hold the actuating relay armature down and the contact points are opened by spring tension. This interrupts the flow of current to the circuit breaker relay shunt winding, causing a sudden loss of magnetic field strength which releases the armature and allows the contact points to open. The sudden interruption of current flow in the circuit shunt winding causes a surge of induced voltage which is partly dissipated by a resistor which is connected in series with the circuit breaker winding (fig. 25) whenever the actuating relay points are open. This resistor action reduces the energy dissipated through arcing at the contacts of the actuating relay.

The reverse current overload relay contains two windings and one set of contact points. One of the windings is a series winding consisting of one turn of heavy wire (shown in fig. 25) which is a part of the charging circuit. The second winding is a shunt winding consisting of many turns of fine wire (shown in dashed lines in fig. 25) which is shunted across the generator. The series and shunt windings are wound so that their magnetic field strengths are added when a reverse current flows, but are opposed when charging current flows to the battery. This gives a directional effect which allows the relay to respond to a moderate reverse current without interfering with the maximum current flow. The armature of the reverse current overload relay is counter-balanced for protection against shock and vibration. It carries a single contact point and is connected to ground. Directly above the armature contact point is a fixed contact point which is connected to the shunt winding of the circuit breaker relay. The contact points are normally held closed by the tension of a spiral spring attached to the back of the armature and to a spring hanger on the relay frame.

Under normal conditions, operation of the actuating and circuit breaker relays is sufficiently rapid to prevent the development of excessive reverse current from the battery when generator voltage drops. However, in unusual circumstances where there is a very sudden decrease in generator voltage, reverse current may build up rapidly enough to reclose the actuating relay before the circuit breaker relay has time to open. Reclosing of the actuating relay, of course, prevents normal opening of the circuit breaker relay since the shunt coil remains energized. In such a case, the overload relay exercises emergency control over the circuit breaker relay by interrupting the ground connection of the circuit breaker relay shunt winding (fig. 25).

QUICK CHECKS OF CHARGING SYSTEM

When analyzing complaints on the charging system, any one of several basic conditions may be found.

1. Fully Charged Battery and Low Charging Rate. This indicates normal operation of the charging system. If desired, regulator settings may be checked as outlined under REGULATOR CHECKS AND ADJUSTMENTS.

2. Fully Charged Battery and a High Charging Rate. This condition is abnormal and indicates that the voltage regulator is not limiting the generator voltage sufficiently or that battery countervoltage is abnormally low. A high charging rate to a fully-charged battery will damage the battery, and, if the high current is accompanied by high voltage, other connected electrical units may be damaged also.

This operating condition may result from:

a. High voltage regulator setting.
b. Short circuit between the charging circuit and generator field circuit, either in the generator, regulator, or wiring.
c. Poor ground connection at regulator.
d. Overheated battery. High battery electrolyte temperature reduces the countervoltage of the battery so that it will accept a high charge rate even though the voltage regulator setting is normal.
e. Defective voltage regulator unit.
f. Defective battery.

If the trouble is not due to an overheated battery, a defective battery, or a poor ground connection at the regulator, determine the cause of trouble as follows. Disconnect the lead from the "FIELD" terminal of the regulator (with the generator inoperative). Start the generator and operate at a speed which normally would produce a charge rate of 30 to 50 amperes. With the field lead disconnected, there should be no generator output. If the generator charges, there is a short circuit between the charging circuit and the field circuit, either in the wiring or generator. If there is no output, the regulator is probably at fault and should be inspected for a high voltage setting, open voltage regulator shunt winding, or mechanically defective voltage regulator unit.

3. Low Battery and High Charging Rate. This is an indication of normal charging system operation. If desired, regulator settings may be checked as outlined under REGULATOR CHECKS AND ADJUSTMENTS.

4. Low Battery and Low Charging Rate. This condition is abnormal and could be due to:

a. Loose or high resistance connections, frayed or damaged wires.

b. Battery with high internal resistance (due to sulfation, poor internal connections, or very low electrolyte temperature).
c. Defects within the generator.
d. Defects within the regulator.

If this condition is not caused by defective wiring or a battery with high internal resistance, proceed as follows to determine whether generator or regulator is at fault.

With the generator operating at a speed which normally would produce a charge rate of 30-50 amperes, momentarily connect a jumper lead between the "ARMATURE" and "FIELD" terminals of the regulator. If generator output does not increase to 30-50 amperes, the generator probably is at fault and should be checked for a dirty or glazed commutator or a shorted armature. If generator output does increase to 30-50 amperes when the jumper lead is connected to the "ARMATURE" and "FIELD" terminals of the regulator, the regulator is at fault and should be checked for a low voltage regulator setting, defective carbon stack, or mechanically defective regulator.

5. Low Battery and No Charging Rate. This condition is abnormal and could be due to:
a. Loose or high resistance connections, frayed or damaged wires.
b. Open-circuited battery.
c. Defects within the generator.
d. Defects within the regulator.

If this condition is not caused by defective wiring or an open-circuited battery, proceed as follows to determine whether the generator or regulator is at fault.

With the generator operating at a speed which normally would produce a charge rate of 10-15 amperes, connect a voltmeter between the "ARMATURE" terminal of the regulator and ground, and momentarily connect a jumper lead between the "ARMATURE" and "FIELD" terminals of the regulator. If the generator voltage does not increase to the normal operating range or higher, the generator probably is at fault and should be checked for an open field circuit, worn or sticking brushes, grounded armature, or a dirty or glazed commutator. If generator voltage does increase to the normal operating range or higher when the jumper lead is momentarily connected to the "ARMATURE" and "FIELD" terminals of the regulator, the regulator probably is at fault and should be checked for an open actuating relay or circuit breaker relay shunt winding, open series circuit, open field circuit, or mechanically defective regulator.

REGULATOR CHECKS AND ADJUSTMENTS

GENERAL INSTRUCTIONS

1. Electrical checks and adjustments may be made either on or off the vehicle, but the regulator always should be operated and checked with the type generator for which it is designed. All voltage checks must be made with the regulator operating on open circuit (with battery disconnected).

2. Final checking and adjusting of the electrical settings must be made with the regulator stabilized at operating temperature and mounted in its operating position.

NOTE: The regulator is considered to be stabilized at operating temperature after it has operated continuously for 30 minutes (with cover in place) with normal to full load or immediately after the vehicle has completed a run of several hours and before the engine is shut down. If the engine has been shut down after a run, operating temperature may be re-established by operating the regulator at normal to full load for a period equal to the down time (up to 30 minutes). This procedure should also be used to make up for time lost in hooking up test equipment or making minor adjustments.

3. The setting of the voltage and current regulators must be checked at a generator speed of 3000 rpm (1750 engine rpm).

4. To eliminate the effects of residual magnetism which otherwise cause inaccurate electrical checks and adjustments, it is necessary to cycle the generator after each electrical adjustment before each check reading is taken. To cycle an operating generator properly, briefly reduce generator voltage below 4 volts, and then bring back to operating voltage. Cycling of the generator may be accomplished through use of a rheostat connected in series with the field circuit or by stopping and starting the generator.

5. After any regulator checks and adjustments on the vehicle requiring leads to be disconnected, the generator should be repolarized after all leads are reconnected and before the engine is started. To properly polarize generators used with carbon pile regulators, disconnect the lead to the "FIELD" terminal of the regulator, and momentarily touch this lead to the "BATTERY" terminal of the regulator. This allows a momentary flow of current through the generator field windings in the proper direction. Failure to do this may result in reversed generator polarity which will cause heavy arcing and burning of the circuit breaker relay contact points.

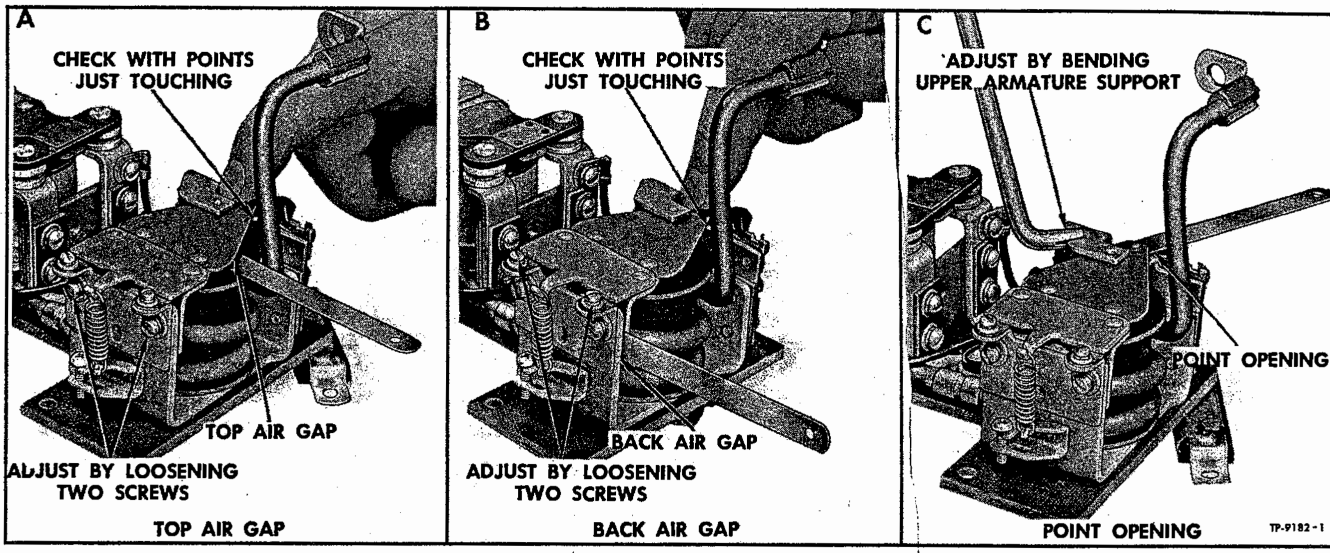


Figure 26—Actuating Relay Mechanical Adjustments

NOTE: Because of the high voltage and potential currents controlled by the carbon pile regulator, it is necessary to use insulated tools in adjusting the various units in operation. Short circuits to ground may seriously damage the regulator. NEVER CLOSE ACTUATING OR CIRCUIT BREAKER RELAY POINTS BY HAND UNLESS GENERATOR IS OPERATING.

Non-magnetic feeler gauges must be used in checking the front air gaps of voltage and current regulators because of the strong magnetic fields created during their operation. Gauges may be made of brass or stainless steel. Other equipment required includes a 15 ohm - 25 watt variable resistor. The variable resistor should have an "OFF" (open circuit) position at extreme left and must be large enough to permit accurate adjustment. (Small resistors having relatively few steps are not satisfactory for this purpose since the voltage cannot be varied smoothly.) Refer to "Specifications" at end of this group for all air gap and point opening dimensions and for voltage and current values.

ACTUATING RELAY

Four checks and adjustments are required on the actuating relay: Top air gap, back air gap, point opening, and closing voltage setting. Unit must be removed from box to make air gap and point opening adjustments, and must be installed to make closing voltage check and adjustment.

TOP AIR GAP

Top air gap (view A, fig. 26) should be measured between armature and winding core with contact points just touching. Hold armature down by hand while measuring air gap. To adjust, free the armature by removing spiral spring, loosening two armature attaching screws, and two contact support screws. Rest the armature on proper size feeler gauge (one flat gauge or two round gauges) to insure its being parallel to the winding core and with proper air gap. Secure setting by tightening two armature attaching screws and adjusting contact support until points just touch, and tighten two support attaching screws. Replace spiral spring.

BACK AIR GAP

Back air gap (view B, fig. 26) should be measured between relay frame and armature with points just touching. Hold armature down by hand while measuring back air gap. Adjust by loosening the two small armature hinge mounting screws and moving armature forward or backward as necessary.

POINT OPENING

Measure point opening (view C, fig. 26) between contact points with armature at rest up against armature stop. Adjust by bending armature stop.

CLOSING VOLTAGE CHECK

Check and adjust actuating relay closing voltage as follows (fig. 27): With generator inoperative, connect a voltmeter between regulator "ARMATURE" terminal and "GROUND" terminal. Disconnect battery lead at "BATTERY" terminal. Disconnect lead from the regulator "FIELD" terminal and connect the 15 ohm - 25 watt variable resistor in series between the lead and terminal. Voltage of generator can now be reduced by cutting in the resistance or increased by cutting out the resistance so that the closing voltage can be checked. Operate generator at a speed well above cut-in speed with full resistance of the variable resistor in field circuit. Gradually increase the voltage by

REGULATOR

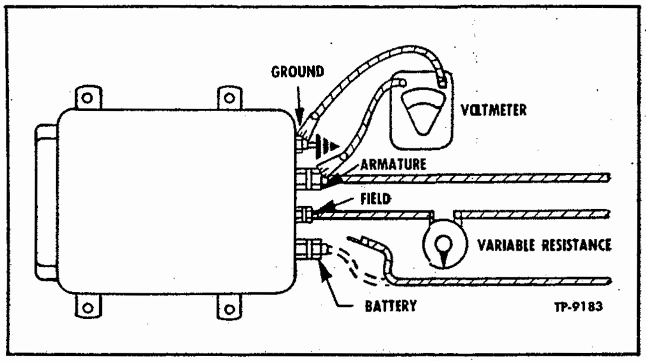


Figure 27—Voltmeter and Resistance Connections For Checking Actuating Relay and Circuit Breaker Relay Closing Voltages and Regulator Setting

cutting out resistance until contact points close and note the closing voltage. Before each check reading, reduce voltage to 4 volts or less and then increase voltage.

CLOSING VOLTAGE ADJUSTMENT

Adjust closing voltage, if necessary, by turning adjusting screw at base of relay frame (fig. 28). Increasing spring tension will increase closing voltage and decreasing spring tension will lower it.

CAUTION: If adjusting screw is turned down (clockwise) beyond the normal range required for adjustment, the spring support may be bent beyond its elastic limit and fail to return when pressure is relieved. In such a case, turn the screw counterclockwise until sufficient clearance develops between screw head and spring support, then bend spring support upward carefully with small pliers until contact is made with screw head. Final setting of the unit should always be approached by increasing the spring tension, never by reducing it. In other words, if the setting is found to be too high, the unit should be adjusted below the required value and then raised to the exact setting by increasing the spring tension.

Figure 28—Actuating Relay Closing Voltage Adjustment

CIRCUIT BREAKER RELAY

Five checks and adjustments are required on the circuit breaker relay: Top air gap, back air

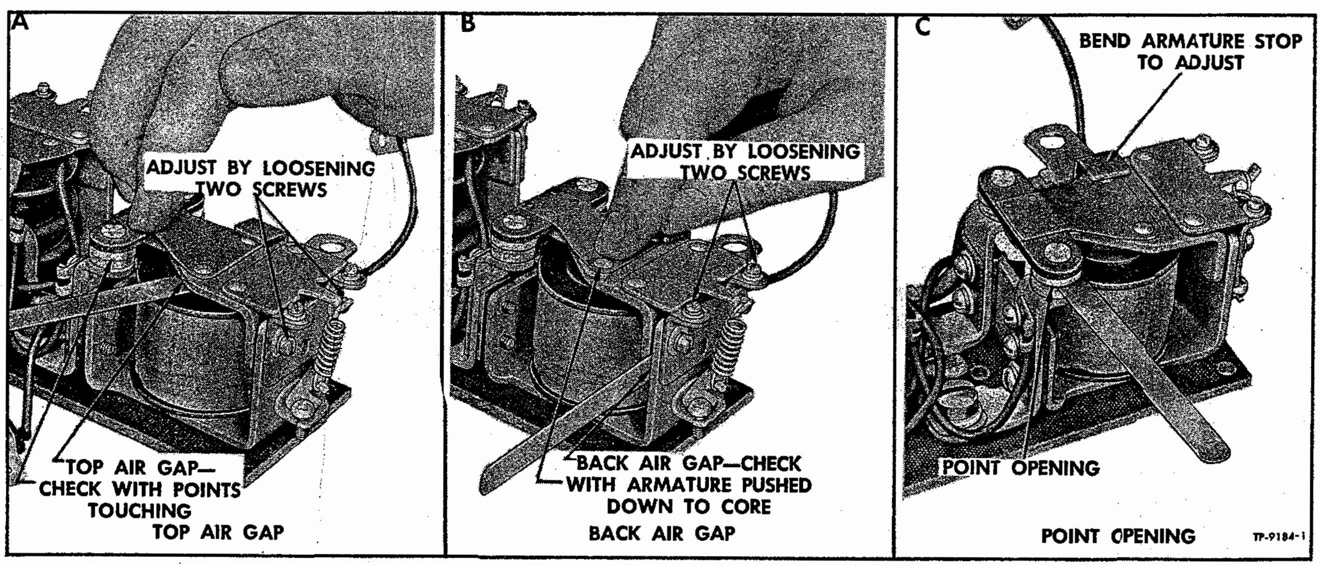


Figure 29—Circuit Breaker Relay Mechanical Adjustments

gap, point opening, closing voltage, and sealing voltage. Unit must be removed from box to make air gap and point opening adjustments, and must be installed to make closing and sealing voltage checks and adjustments.

TOP AIR GAP

Top air gap (view A, fig. 29) is measured between armature and core with contact points just touching. Hold contacts closed by placing finger on contact bar. To adjust, free the armature by removing the spiral spring, loosening 2 armature attaching screws, and loosening both contact supports. Rest the armature on proper size gauge (one flat or two round) to insure its being parallel to the winding core and with proper air gap. Secure the setting by tightening two armature attaching screws and by adjusting both contact point supports until points just touch. Secure contact supports by tightening attaching screws. Replace spiral spring.

BACK AIR GAP

Back air gap (view B, fig. 29) is measured between relay frame and armature with armature touching core. Armature should be held down by placing the finger near the armature stop while measuring. Adjustment is made by loosening two small armature hinge screws and moving armature forward or back as required. Be sure hinge screws are tightened securely after adjustment.

CONTACT POINT OPENING

Contact point opening is measured as shown in view C, figure 29. Adjust by bending armature stop. Be sure both sets of contact points close at the same time.

CLOSING VOLTAGE CHECK

Closing voltage of circuit breaker relay is measured in same manner as that previously described for the actuating relay (fig. 27). Be sure to lower the voltage to 4 volts or less before each test reading, and hold the actuating relay armature down by hand so that contact points are closed during test. The lead must be disconnected from generator regulator "BATTERY" terminal while making this test.

SEALING VOLTAGE CHECK

To check sealing voltage, continue to raise the voltage after points close until armature seals to core. (This is usually accompanied by an audible click.) Note voltage.

CLOSING VOLTAGE ADJUSTMENT

Closing voltage may be adjusted, if necessary, by turning adjusting screw (fig. 30) at base of relay frame. Closing voltage is increased by increasing spring tension and decreased by reducing it.

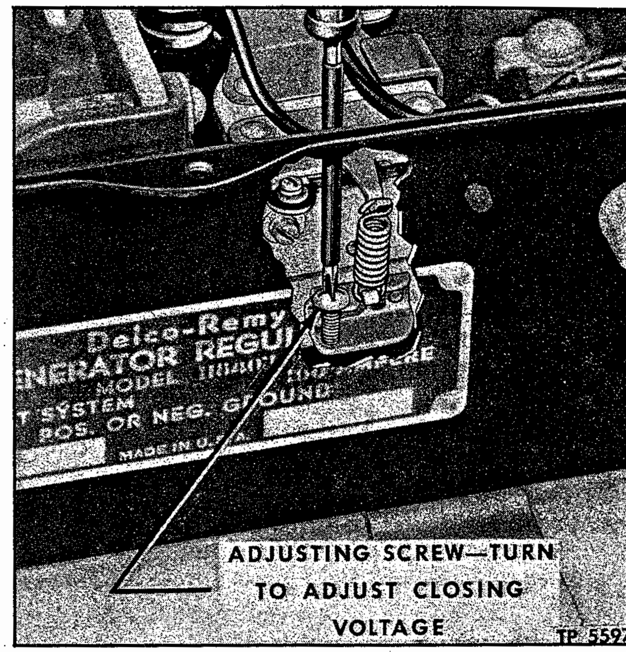


Figure 30—Circuit Breaker Relay Closing Voltage Adjustments

CAUTION: If adjusting screw is turned down (clockwise) beyond the normal range required for adjustment, spring support may be bent beyond its elastic limit and fail to return when pressure is relieved. In such a case, turn screw counterclockwise until sufficient clearance develops between screw head and spring support, then bend spring support upward carefully with small pliers until contact is made with screw head. Final setting of the unit should always be approached by increasing the spring tension, never by reducing it. In other words, if the setting is found to be too high, the unit should be adjusted below the required value and then raised to the exact setting by increasing the spring tension.

SEALING VOLTAGE ADJUSTMENT

Sealing voltage is the voltage at which the armature seals to the core. This value may be adjusted by resetting the air gap or closing voltage within specified limits. Reducing air gap lowers sealing voltage and increasing air gap will raise sealing voltage. Normally, only newly installed armatures require adjustment. Recheck closing voltage after adjusting sealing voltage.

VOLTAGE REGULATOR

Three checks and adjustments are required on the voltage regulator: Back air gap, front air gap, and voltage setting. Back air gap must be checked under load; check can be made with unit in box, but must be removed from box to make back air gap adjustment. Unit must be installed to adjust front air gap and voltage setting.

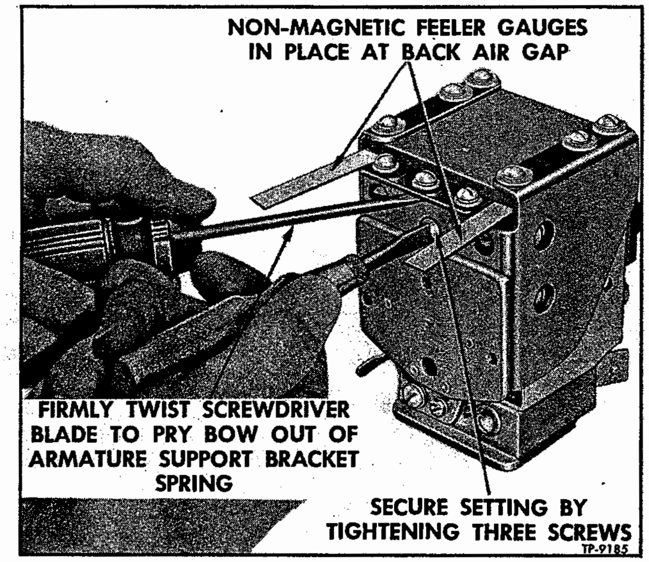


Figure 31—Voltage Regulator Back Air Gap Adjustment

BACK AIR GAP

With non-magnetic feeler gauges, measure at both sides of regulator frame (fig. 31) between armature and regulator frame with armature loaded. Air gaps must be within 0.006" of each other to insure the armature being parallel. Load the armature by connecting a battery between winding terminal and ground to energize the winding, using a 6-volt battery. Do not use a battery of higher voltage than specified since false settings may result.

To adjust or reset the back air gap, proceed as follows: Remove unit from box. Loosen armature support attaching screws only enough to permit armature to be lightly tapped up or down. Using feeler gauges of the widest limit of air gap range, place one gauge on each side of regulator between armature and regulator frame. Lightly tap armature in position against feeler gauges, but not snug against gauges. Use screwdriver blade as shown (fig. 31) to pry bow out of armature spring support bracket. Tighten armature support attaching screws to secure setting (fig. 31). Load the armature by connecting a 6-volt battery to the winding terminal and ground to energize the winding. With armature loaded, measure air gaps. Final adjustment, if necessary, may now be made by slightly loosening attaching screws and tapping armature up or down as required.

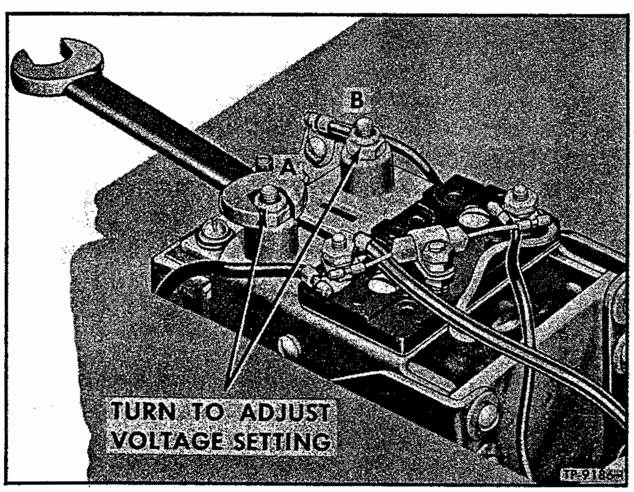


Figure 32—Voltage Regulator Voltage Setting

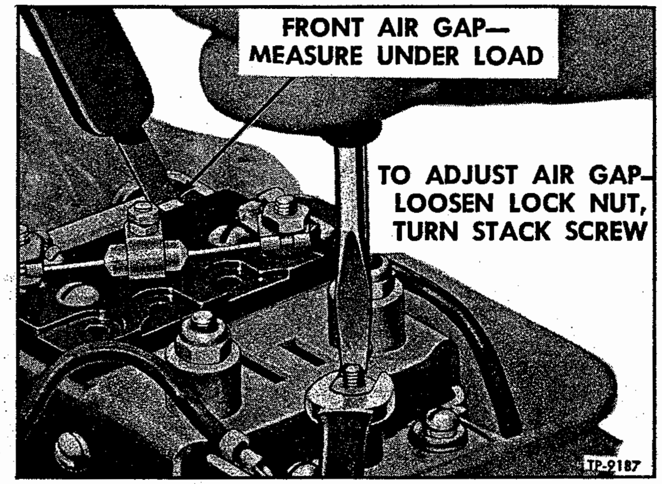


Figure 33—Voltage Regulator Front Air Gap Adjustment

FRONT AIR GAP

Unit must be in the box and operating at approximately operating voltage. Disconnect lead to regulator "BATTERY" terminal. Disconnect lead to regulator "FIELD" terminal, connect the variable resistance in series between lead and "FIELD" terminal, and set resistance to "OFF" (open circuit) position (fig. 27). Operate generator at specified speed and gradually cut out variable resistance. (If voltage tends to exceed the specified limit before resistance is entirely cut out, loosen one voltage adjusting nut (fig. 32) until resistance may be cut out without exceeding maximum limit.) With regulator at specified voltage and using non-magnetic feeler gauge, measure front air gap between armature and frame of voltage regulator (fig. 33). Make adjustment, measuring the side having the smallest air gap. First, tighten one of the adjusting nuts of the current regulator to insure its not having a low setting. Next, adjust voltage regulator front air gap by loosening the carbon stack adjusting screw lock nut and turning the screw. Be sure to maintain the specified voltage setting while adjusting air gap. After adjustment, secure setting by tightening lock nut.

VOLTAGE SETTING

Disconnect lead to regulator "BATTERY" terminal. Connect a voltmeter between "ARM-

ATURE" and "GROUND" terminals (fig. 27). Set system voltage rheostat on side of generator regulator box to halfway position. This can be done by turning the slotted screw to right and to the left as far as possible and marking these limits with a pencil, and then returning the screw to mid-point between these marks. (Do not force adjusting screws past stops.) The system voltage rheostat adjusting screw is protected by a hex head plug that should be replaced when adjustment is complete.

Disconnect lead at regulator "FIELD" terminal, connect the variable resistance in series between lead and "FIELD" terminal, and set resistance to "OFF" (open circuit) position (fig. 27). Operate generator at approximately 3000 rpm (1750 engine rpm), and gradually cut out variable resistance. (If voltage tends to exceed the specified limit before resistance is entirely cut out, loosen voltage adjusting nut until resistance can be completely cut out without exceeding maximum limit.) To adjust, slowly loosen voltage adjusting nut "A" (fig. 32). Generator voltage will fall until spring tension is relieved. Loosen only until voltage stops falling. Further loosening may allow spring to unhook. Gradually adjust voltage adjusting nut "B" until approximately 8 or 9 volts is obtained.

Tighten adjusting nut "A" to specified setting. Reduce generator voltage to 4 volts or less by the variable resistance in field circuit. Raise voltage again by cutting out variable resistance and note voltage setting. (Cycle regulator in this manner each time a change is made to assure a stabilized reading.) If voltage setting is within 3 volts of specified setting, adjust nut "A." If more than 3 volts, repeat previous directions by relieving tension on nut "A" and adjusting nut "B" to 8 or 9 volts, etc.

CURRENT REGULATOR

Three checks and adjustments are required for the current regulator: Back air gap, front air gap, and current setting. Unit must be removed from box to adjust back air gap, and must be installed to adjust front air gap and current setting.

BACK AIR GAP

Measure at both sides of regulator frame between armature and regulator frame and with armature loaded. The air gaps must be within 0.006" of each other to insure the armature being parallel. Load the armature by placing the heel of the hand squarely on top of armature and press down (fig. 34). A force of about 30 to 40 pounds is sufficient.

To adjust or reset back air gap, proceed as follows: Loosen bracket adjusting screws only enough to permit armature to be lightly tapped up or down as required. Using feeler gauges of the widest limit of air gap range, place a gauge on each side of regulator between armature and regulator frame. Load the armature, adjust to feeler gauges, and secure by tightening adjusting screws. Remove feeler gauges, and again load the armature and recheck air gap. Repeat this procedure until setting is as specified.

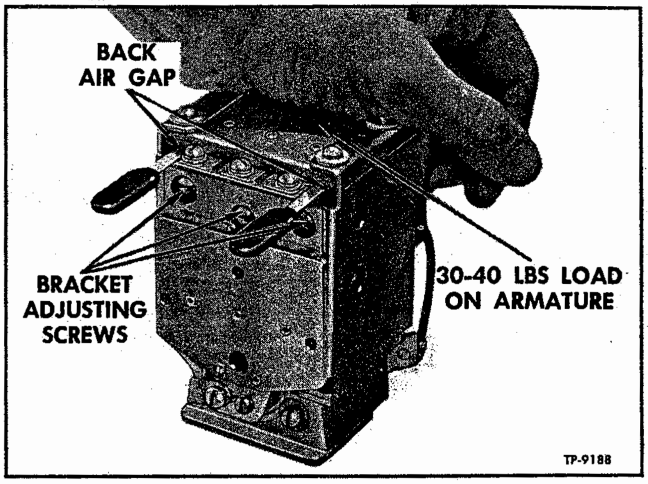


Figure 34—Checking Current Regulator Back Air Gap Adjustment

FRONT AIR GAP

Unit must be in the box and under operating load. Disconnect battery lead from regulator "BATTERY" terminal and connect a suitable test ammeter in series with the lead and "BATTERY" terminal. Disconnect lead from "FIELD" terminal and connect in series the variable resistance between lead and "FIELD" terminal (fig. 35). Set variable resistor to "OFF" (open circuit) position. Turn on all electrical load or enough to exceed the specified setting of current regulator. If all electrical load is not enough, then suitable resistance must be placed across the battery to exceed the current setting.

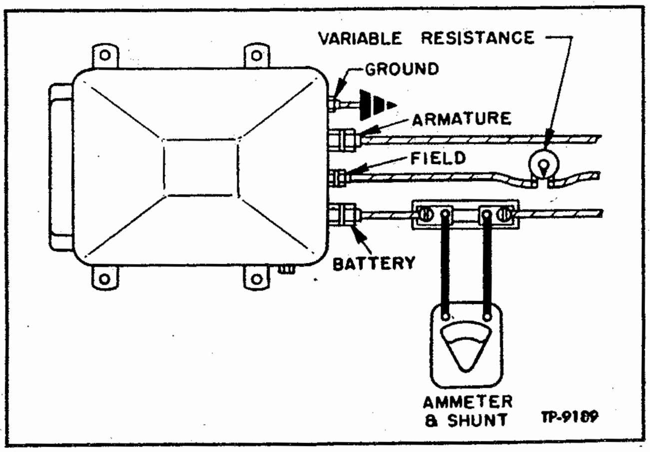


Figure 35—Ammeter, Shunt, and Resistance Connections For Checking Current Regulator Front Air Gap

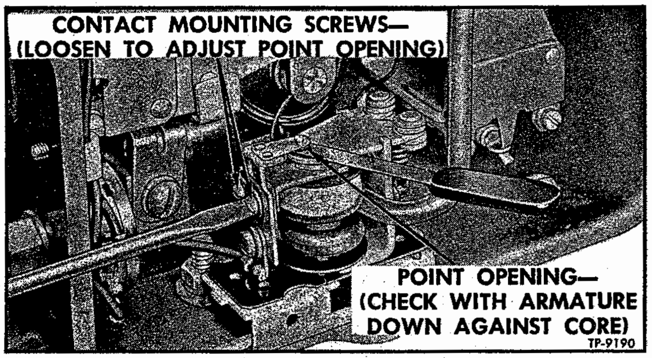


Figure 36—Reverse Current Overload Relay Point Opening Adjustment

Operate generator at approximately 3000 rpm (1750 engine rpm) and slowly raise generator output by cutting out the variable resistor until resistance is all out. (If current tends to exceed specified limit before resistance is entirely cut out, loosen the current adjusting nut "A" until resistance can be completely cut out without exceeding the specified current limit.) With regulator at specified load and using non-magnetic feeler gauges, measure front air gap and make adjustment in the same manner as previously described for voltage regulator. During adjustment of front air gap, keep output within specified setting.

CURRENT SETTING

To check current setting, disconnect battery lead from regulator "BATTERY" terminal and connect a suitable test ammeter in series with the lead and "BATTERY" terminal. Disconnect lead from "FIELD" terminal and connect in series the variable resistance between lead and "FIELD" terminal (fig. 35). Set variable resistor to "OFF" (open circuit) position. Turn on all electrical load or enough to exceed the specified setting of current regulator. If all electrical load is not enough, then suitable resistance must be placed across the battery to exceed the current setting. If not enough load is available, no attempt to adjust the current regulator should be made. If load is available, it must be enough to bring the operating voltage down one volt below operating voltage.

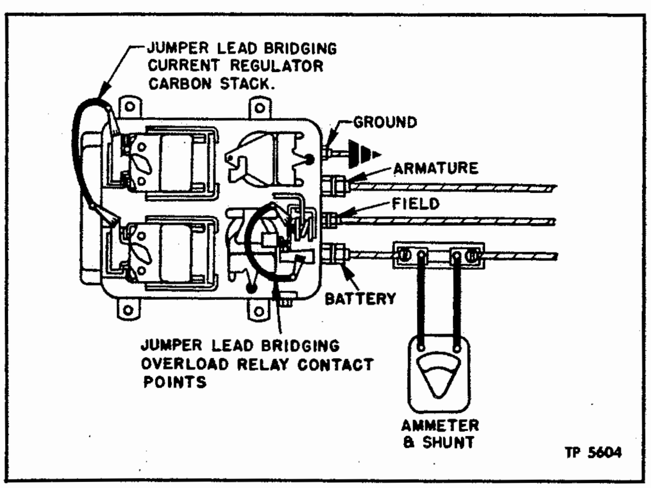


Figure 37—Ammeter, Shunt, and Jumper Lead Connections For Checking Overload Relay Reverse Current Setting

Operate generator at 3000 rpm (1750 engine rpm) and slowly raise generator output by cutting out the variable resistor until resistance is all out. (If current tends to exceed specified limit before resistance is entirely cut out, loosen the current adjusting nut "A" until resistance can be completely cut out without exceeding the specified current limit.) To adjust (fig. 32), loosen adjusting nut "A" on current regulator slowly. As nut is loosened, generator output will fall until the spring tension is relieved. Loosen only until output stops falling. Further loosening may allow spring to unhook. Next, adjust nut "B" until output stops falling. Further loosening may allow spring to unhook. Next, adjust nut "B" until output is six-tenths of specified output. Then finish the adjustment with nut "A" to the specified output.

REVERSE CURRENT OVERLOAD RELAY

The reverse current overload relay requires two checks and adjustments; point opening and reverse current setting.

POINT OPENING

Hold reverse current overload relay armature against core and measure point opening (fig. 36). To adjust, loosen two contact support attaching screws and move support as required. Tighten screws securely after setting.

REVERSE CURRENT

Connect a temporary jumper lead across reverse current overload relay contact points to prevent the circuit breaker relay points opening during test (fig. 37). Shunt out the carbon stack of the current regulator with a temporary jumper lead to prevent current regulator action on reverse current. Connect a suitable test ammeter in series with battery lead and regulator "BATTERY" terminal. Disconnect lead from "FIELD" terminal of regulator, connect the variable resistor in series with this lead and "FIELD" terminal, and cut out all resistance. Operate generator at a speed slightly above the closing of the actuating and circuit breaker relays. Hold armature of actuating relay down by hand and slowly reduce generator voltage by cutting in variable resistance unit until reverse current causes overload relay contact points to open. Note the reverse current setting. Increase generator voltage by cutting out the variable re-

sistance. To adjust reverse current setting (fig. 38), bend spiral spring hanger up to decrease setting or down to increase the setting.

CORRECTION OF EXCESSIVE STACK RESISTANCE

Some cases of discharged batteries may be the result of excessive resistance that builds up in the carbon stack of the voltage regulator unit which raises the cut-in speed of the generator. The carbon stack has a tendency to develop a high residual resistance as a result of prolonged periods of undisturbed or static operation. There is no noticeable change in the appearance of the carbon discs. Excessive resistance in the carbon pile is caused primarily by improper contact between adjacent discs in the stack. Proper contact is essential, since the resistance of the carbon pile is controlled by minute changes in length of stack which varies the contact pressure of the disc surfaces.

The residual resistance of the carbon stack can be returned to normal by disturbing the discs slightly, restoring proper disc contact. This can be accomplished without removing the unit, and should be done at intervals of not more than 25,000 miles.

Check For Excessive Resistance

1. Connect a tachometer to tachometer takeoff on engine.
2. Disconnect cable leading from master circuit breaker at "BATTERY" terminal of regulator.
3. Connect a voltmeter from "ARMATURE" terminal on regulator to a good ground.
4. Run engine at 1500 rpm and note voltmeter reading. Normal open circuit voltage is approximately 14.3 volts. If voltmeter reading is 13.9 volts to 14.3 volts, proceed with test. If less than 13.9 volts adjust voltage setting to 14.3 volts as directed under "VOLTAGE REGULATOR."
5. Increase engine speed slowly from idle and note speed at which the voltmeter reads 13 volts. If more than 800 rpm is required to obtain 13 volts, excessive carbon stack resistance is present.

Removal of Excessive Resistance

1. Remove cover from regulator.
2. Using a jumper lead, connect one end of jumper to battery junction stud above regulator (fig. 7). Connect other end of jumper to terminal post on bakelite block of voltage regulator as shown in figure 39. NOTE: There are two terminal posts on voltage regulator; connect jumper lead to the same terminal to which the small lead from system voltage rheostat is connected.
3. With jumper connected, lightly tap voltage regulator stack adjusting screw with handle of a small screwdriver (fig. 39).

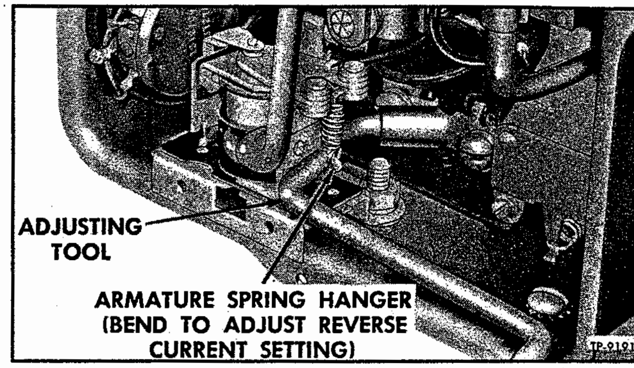


Figure 38—Overload Relay Reverse Current Adjustment

4. As a final check, remove the jumper lead and repeat step 5 under "Check for Excessive Resistance" above. An improvement in generator performance should be noted.
5. Recheck the voltage regulator setting before disconnecting the voltmeter, since the setting may have increased slightly due to removal of excessive resistance in the carbon stack.
6. After completing the above procedure, reconnect master circuit breaker cable to "BATTERY" terminal on regulator.

POLARITY

After the generator or regulator is reinstalled, or at any time after leads have been disconnected

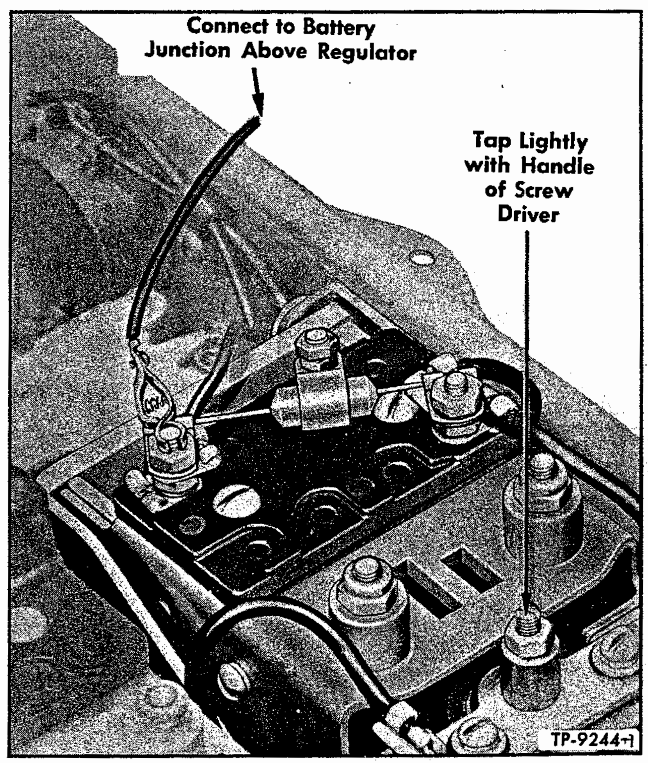


Figure 39—Correcting Excessive Resistance in Stack

and then reconnected to the regulator, the lead to the "FIELD" terminal of the regulator should be removed and touched momentarily to the "BATTERY" terminal of the regulator, before starting the engine. This allows a momentary surge of current from the battery through the generator field windings which correctly polarizes the generator with respect to the battery it is to charge.

Lighting System

Circuits for all lights used for regular illumination purposes are shown on "Coach Lighting Wiring Diagram" (MD-75571). Circuits for lights used as signals, such as stop light, directional signals, and tell-tale lights are shown on "Alarm and Signal Wiring Diagram" (MD-79109). IMPORTANT: All lights should be checked daily and necessary replacements made. Bulb sizes are listed in "Specifications" at end of this group. A spare headlight Sealed-Beam unit, fog light bulb, stop light or directional light bulb, and tail or marker light bulb are carried in a carton in safety compartment.

SWITCHES AND CIRCUIT BREAKERS

All manually operated light switches for exterior and interior lighting equipment, except engine compartment lights, driver's light, and spotlight, are located on switch panel in front of driver or on floor board at driver's feet. Engine compartment lights are operated by a manual switch on engine compartment control panel. Driver's light operating switch is located on control panel at left of driver. Spot light operating switch is located on handle of light.

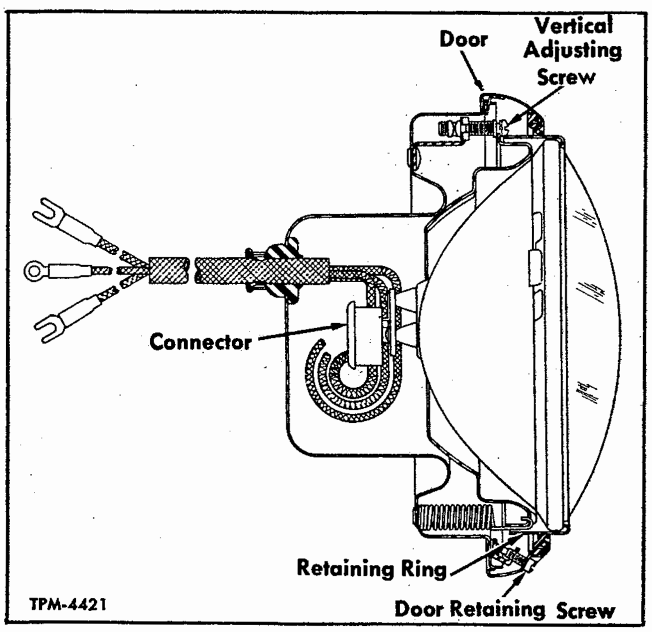


Figure 40—Headlight

Baggage compartment light circuits are controlled by individual switches which are automatically operated by the opening and closing of each baggage compartment door.

Stop lights are controlled by an air-operated switch as explained later under "Exterior Lighting."

All lighting circuits are protected by automatic reset type circuit breakers. All lighting circuit breakers are located on lower panel at left of driver, except circuit breakers for general and reading lights which are located in electrical compartment at right rear side of coach. Refer to "Wiring Diagrams" in back of manual or to circuit breaker tabulations in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

EXTERIOR LIGHTING EQUIPMENT

HEADLIGHTS

Headlights (fig. 40) are double-filament, Sealed Beam type. The lens, reflector, and filament are a sealed unit and can be replaced only as such. If lens is cracked, filament burned out, or reflector damaged, the complete unit must be replaced.

With switch marked "HEAD LAMPS" on panel turned on, headlight and fog light circuits are energized. The headlight or fog light circuit is then selected by the foot-operated selector switch on floor-board. When headlights are used, upper or lower headlight beam is selected by the foot-operated dimmer switch on floorboard. Tell-tale light on gauge panel marked "HI BEAM" illuminates when headlight upper beam is being used. Headlight circuit is protected by number 11 circuit breaker on panel at left of driver.

Proper Use of Headlights

Headlights are designed to provide adequate highway lighting for normal operating conditions. The headlights will provide safe lighting, providing they are aimed correctly, equipped with proper Sealed-Beam units, lens are clean, and upper and lower beams are used correctly.

1. Upper Beam. High beam should be used only on unlighted roads when no approaching vehicles are near.

2. Lower Beam. Lower beam should always be used when approaching another vehicle. The depressed beam provides safer road visibility than

upper beam under passing conditions, providing both vehicles use the depressed beam.

3. Headlight Lens. Dirt on lens absorbs a considerable amount of light. Clean lens with water. and a good glass cleaner whenever dirty.

4. Headlight Wiring. For maximum illumination, proper voltage must be obtained at the bulb. Discharged battery, loose or dirty electrical contacts in wiring system, and poor ground connections all contribute to a decrease in voltage. Check wiring and connections regularly, make sure generator is charging sufficiently, and keep battery properly charged.

Sealed-Beam Unit Replacement (Fig. 40)

Headlight Sealed-Beam unit may be replaced in following manner:

1. Remove door retaining screw and remove door.
2. Remove three retaining ring screws.
3. Pull Sealed-Beam unit out of light body, Disconnecting wiring as unit is removed.
4. Insert prongs of new Sealed-Beam unit into wiring plug, then position unit in light body.
5. Install Sealed-Beam unit retaining ring and attach to light body with three screws.
6. Install door with clip engaging slot at top of light body. Install door retaining screw at bottom of door, tightening screw firmly.

Headlight Adjustment

Headlights must be aimed carefully and accurately to assure safe vehicle operation at night. Adjustments can be made quickly and accurately with a headlight tester, but if such equipment is not available, adjust lights as follows:

1. Position vehicle on level floor with headlights 25 feet from a vertical wall or door as shown in figure 41. Vehicle center line must be perpendicular to vertical surface.
2. Draw a horizontal line on vertical surface at height of light center as shown in figure 41. Locate a point on this horizontal line at which projected center line of chassis intersects. Measure distance between light centers and divide the distance equally on either side of center mark. Then draw a vertical line directly ahead of each light center as shown.
3. Switch on high or bright beam in headlights and cover one light while adjusting other.
4. Remove door retaining screw (fig. 40) and door for access to adjusting screws. Top screw provides vertical adjustment and side screw aims light horizontally.
5. Beam pattern should approximate that shown in figure 42. A distorted beam pattern is usually caused by a sprung reflector, in which event Sealed-Beam unit must be replaced.
6. After headlight is properly aligned, cover

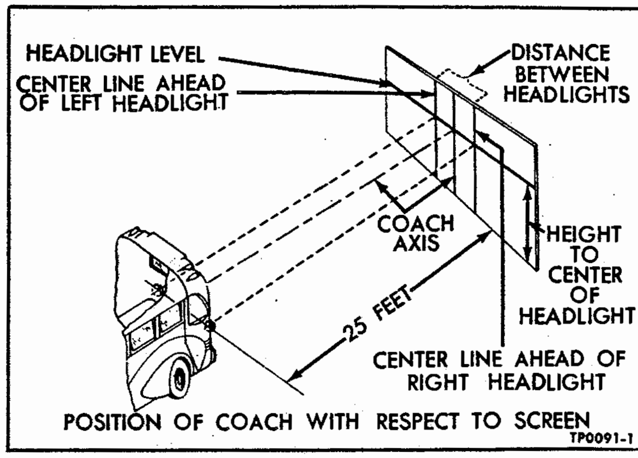


Figure 41—Headlight Aiming Chart

its beam and proceed in same manner as above with opposite light.

HEADLIGHT DIMMER SWITCH, AND HEAD AND FOG LIGHT SELECTOR SWITCH

Foot-operated switches located on floorboard near clutch pedal are used to select either the headlight or fog light circuit, and to select either headlight upper or lower beam when headlights are being used. These switches are operative only when switch marked "HEAD LAMPS" on panel is in "ON" position. Rearward foot-operated switch is the headlight dimmer switch. Forward foot-operated switch is the head and fog light selector switch.

Switches require no maintenance; however, switch may be replaced by removing mounting screws, after which switch is readily accessible from under floor through tool compartment.

When installing foot-operated switch, connect wires to terminals before attaching switch to floor boards. IMPORTANT: Correct wire must be connected to switch terminal marked "BAT" as follows: Dimmer switch - black with red check; selector switch - black with two green parallel tracers. Connect other two wires to remaining terminals; position of these wires with respect to terminals is not important.

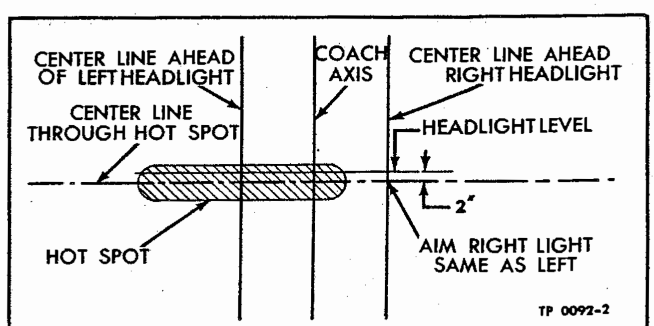


Figure 42—Headlight Beam Pattern

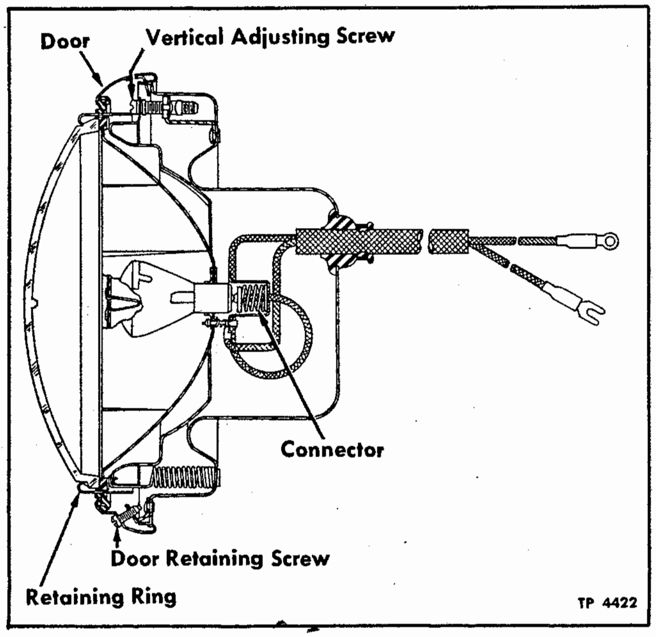


Figure 43—Fog Light

FOG LIGHTS

Fog lights (fig. 43) are mounted at lower front corners of coach directly below headlights and behind outer ends of front bumper. Holes are provided in bumper at fog lights. A bulb with a metal fog cap to prevent glare from direct rays, and an amber lens are the identifying characteristics of this type of light.

Fog light circuit is energized by foot-operated selector switch after switch marked "HEAD LAMPS" on panel is in "on" position. Either the headlights or fog lights are on when the "HEAD LAMPS" switch is on, never both at the same time.

Fog Light Bulb Replacement (Fig. 43)

1. Remove two spare tire compartment door special lug bolts located in bumper opening between fog light openings. Swing bumper and spare tire compartment door downward.
2. Remove fog light door retaining screw, then remove door.
3. Remove three retaining ring screws, then remove retaining ring and lens.
4. Press in on bulb, at same time turning bulb counterclockwise to remove bulb.
5. Position new bulb in light with prongs engaged in holes in bulb flange. Due to prong spacing bulb can be installed in only one position.
6. Press bulb in firmly, turning bulb clockwise at the same time. Make sure all prongs are properly engaged.
7. Install lens, retaining ring, and three retaining ring screws.
8. Install door, engaging clip on door in slot at top of light body. Fasten door with screw.
9. Swing bumper and tire compartment door up into position and secure with two lug bolts.

Fog Light Adjustment

Refer to "Headlight Adjustment" previously in this section. Fog lights are adjusted in same manner as headlights; however, beam pattern differs from headlight pattern. Fog light "Hot Spot" is more concentrated around center line of light and "cut-off" at top of beam is more sharply defined than on headlights. Swing bumper and tire compartment door downward as directed in step 1 under "Fog Light Bulb Replacement" for access to fog lights.

MARKER LIGHTS

All marker lights are controlled by switch marked "MARKER" on switch panel and are protected by number 10 circuit breaker on panel at left of driver.

Front and rear corner marker lights are attached to body at roof corners. For access to bulbs, remove two screws which attach lamp body and lens to lamp back assembly. Remove body and lens.

Front and rear Michigan Marker Lights are mounted on roof panel at center of coach. Each bulb is accessible after loosening two screws attaching retainer and lens to light body; then remove retainer, lens, and gasket.

TAILLIGHTS

Taillights are mounted at lower rear corners of coach directly below stop lights on engine compartment door. Taillight circuit is controlled by switch marked "MARKER" on switch panel and is protected by number 10 circuit breaker on panel at left of driver. Refer to "Coach Lighting Wiring Diagram" (MD-75571) for taillight circuit.

Taillight bulb is accessible after removing two screws attaching lens retainer to light body and removing retainer, lens, and gasket as an assembly.

STOP LIGHTS

Stop light at each rear corner of coach on engine compartment door serves also as rear directional signal light. Each stop light is controlled by both the stop light circuit and the directional signal light circuit.

Stop light circuit is controlled by an air-operated switch mounted in air line near brake application valve in tool compartment at left front of coach. Circuit is also controlled by a relay mounted on lower panel at left of driver. Stop light circuit is protected by number 16 circuit breaker also located on lower panel at left of driver. Refer to "Alarm and Signal Wiring Diagram" (MD-79109) for stop light circuits.

Tell-tale light, marked "STOP," on switch panel in front of driver illuminates when stop lights are illuminated. Tell-tale is controlled by a relay and will not light if a stop light bulb is burned out.

Stop light bulb is accessible after removing screw attaching stop light door, reflector, and lens as an assembly to light body; then removing three springs which retain reflector and lens to light door. Make sure gasket is in good condition and properly positioned when installing lens.

STOP LIGHT SWITCH (Fig. 44)

Air-operated stop light switch is connected in air lines near brake application valve located in tool compartment. When brakes are applied, contacts within switch are closed by air pressure, completing circuit to stop light relay.

Switch Removal

Disconnect wires from switch terminals, then unscrew switch from fitting on air line.

Switch Repair

Disassemble switch and examine diaphragm and contact points. Replace diaphragm if cracked or damaged. If contact points are only slightly burned or pitted, they may be reconditioned using a contact point file. If points are badly damaged, terminal screw and contact plunger with new points should be installed. Replace spring if weakened by rust or corrosion. Make sure vent hole in cover is open.

Switch Installation

Thread switch onto fitting in air line. Connect wires to switch terminals. Apply brakes and check operation of stop lights.

STOP LIGHT RELAY

Operation, maintenance, and adjustment of stop light relay are described under "Relays," in "WIRING AND MISCELLANEOUS ELECTRICAL" section at beginning of this group.

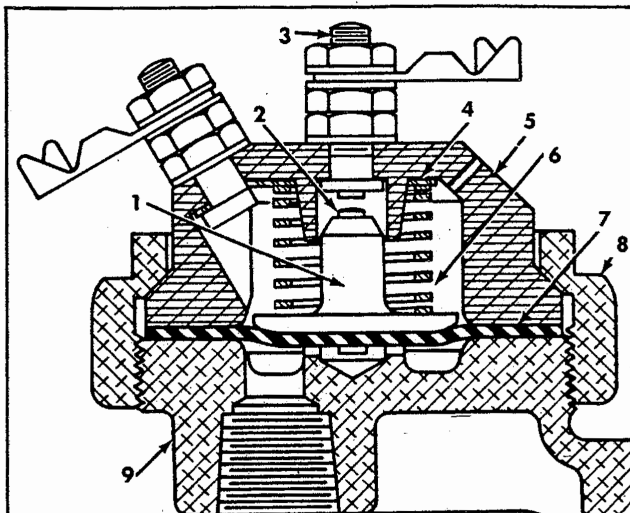
DIRECTIONAL SIGNAL LIGHTS

Directional signal lights are controlled by a self-cancelling switch mounted on steering gear column. Pulling switch lever up turns on left front and rear directional lights, and pressing lever down turns on right directional lights. When turn is completed, switch lever automatically returns to "OFF" position.

Tell-tale light on switch panel in front of driver flashes "DIRECT" when either the right or left signal lights are illuminated.

Directional signal light circuit is protected by number 9 circuit breaker on panel at left of driver. Refer to "Alarm and Signal Wiring Diagram" (MD-79109).

Rear directional signal lights are interposed in stop lights mounted on engine compartment door. When directional signal circuit to stop light is energized, flasher in circuit flashes on and off causing stop light to react likewise; thus the stop light functions as a device to signal the anticipated maneuver of vehicle operator.



1 Contact Plunger
2 Contact Points
3 Terminal Screw
4 Terminal Strap
5 Cover
6 Spring
7 Diaphragm
8 Cover Retainer
9 Body

TP-8413

Figure 44—Stop Light Switch

Front directional signal lights are mounted at each side of coach front end under windshield.

Front and (rear - stop light) directional light bulbs are accessible as previously directed under "Stop Lights."

LICENSE PLATE LIGHTS

License plate lights, mounted directly over license plate holder at rear center of vehicle on inner side of engine compartment door, are controlled by "MARKER" switch on switch panel.

Bulb is accessible for replacement after opening engine compartment door. Pull bulb and socket from light base.

DESTINATION SIGN LIGHTS

Three bulbs, mounted behind destination sign curtain, provide illumination for destination sign. Lights are controlled by switch marked "SIGN" on switch panel. Light circuit is protected by number 10 circuit breaker on panel at left of driver. Refer to "Coach Lighting Wiring Diagram" (MD-75571) for wiring circuit. Bulbs are accessible for replacement from inside coach after lowering sign and door, then lifting top curtain roller from bearing at right side.

SPOT LIGHT

Spot light is mounted through front corner post at left of windshield. Beam is directed by handle, which also contains the light switch, from inside coach. Spot light circuit is protected by number 10 circuit breaker on panel at left of driver. Spot light is equipped with Sealed-Beam unit.

To replace Sealed-Beam unit, remove screw attaching spot light ornament to top of light body and remove ornament; then remove retainer ring and lens which are attached to light body with screw. Remove Sealed-Beam unit from light body and disconnect wires from back of unit. Install new Sealed-Beam unit by reversing the above procedure.

INTERIOR LIGHTING EQUIPMENT

GAUGE PANEL LIGHTS

Gauges in gauge panel in front of driver are illuminated when "MARKER" switch on switch panel is placed in "ON" position.

Light bulbs are accessible by pulling bulb socket free from back of panel. Bulb can then be removed from socket. After replacing bulb, press socket firmly into back of panel housing.

STEPWELL LIGHTS

Front entrance door stepwell is illuminated by light mounted on body inside front panel. Light circuit, protected by number 10 circuit breaker on panel at left of driver, is energized when "MARKER" switch on switch panel is placed in "on" position. Circuit is further controlled by a switch which is actuated by the door control linkage. Switch is located under dash panel at right of driver. Lights operate only when "MARKER" switch is placed in "on" position and door is open.

To replace bulb, remove lens and retainer which are secured to light body with two screws.

GENERAL (DOME) LIGHTS

General interior lights are mounted on package rack edge (12 each side), and are controlled by switch on switch panel. With switch in "GEN'L" position, circuit through general lighting magnetic switch is electrical compartment is energized. This circuit is protected by number 12 circuit breaker on panel at left of driver. Magnetic switch points then close and complete circuits to lights. Magnetic switch-to-light circuits are protected by circuit breakers in electrical compartment; number 1 circuit breaker protects right side light circuit, and number 2 circuit breaker protects left side light circuit. Refer to "Coach Lighting Wiring Diagram" (MD-75571). Bulbs are accessible after removing package rack edge cover which is secured to edge with screws. Screws are located on package side of package rack edge cover.

READING LIGHTS

Reading lights are mounted on under side of package racks (ten each side and one above rear lounge seat), and may be controlled by one of four switches: "GEN'L-READ," "HEAD LAMP," "MARKER," or "ENGINE STOP-RUN." When controlling switch is turned on, circuit through reading light magnetic switch in electrical compartment is energized. Magnetic switch points then close and complete circuits to reading lights. Circuit through switch to magnetic switch is protected by number 12 circuit breaker at left of driver. Magnetic switch-to-reading light circuits are protected by circuit breakers in electrical compartment; number 3 circuit breaker protects right side light circuit and number 4 circuit breaker protects left side.

Individual switches at each light permits passenger control of lights. Refer to "Coach Lighting Wiring Diagram" (MD-75571).

Each light has two bulbs and two switches, except rear lounge light which has only one bulb. To replace bulbs in reading lights, remove light housing with two screws. To replace bulb in rear lounge light, loosen screw in light door and swing hinged door downward.

DRIVER'S LIGHT

Driver's light, mounted on trim panel above driver's window, is controlled by switch marked "DRIVER'S LIGHT" located on control panel at left of driver. Driver's light circuit is protected by number 17 circuit breaker on panel at left of driver. Bulb is accessible after removing lens and retainer which are secured to light body with three screws.

TELL-TALE LIGHTS

Use of tell-tale lights is described under "Tell-tale Alarm System" in "WIRING AND MISCELLANEOUS ELECTRICAL" section. Refer to "Alarm and Signal Wiring Diagram" (MD-79109) for tell-tale circuits.

BAGGAGE COMPARTMENT LIGHTS

Baggage compartment lights are controlled by individual switches as each door is opened and closed. Compartment light circuit is protected by number 17 circuit breaker on panel at left of driver. Bulbs are accessible after pulling light socket with bulb from light body.

ENGINE COMPARTMENT LIGHTS

Engine compartment lights are controlled by a switch on engine compartment control panel. Compartment light circuit is protected by number 6 circuit breaker in electrical compartment at right rear of coach. Bulbs are exposed and are readily accessible for replacement.

EMERGENCY DOOR LIGHT

Emergency door light is mounted in reading light panel above emergency door. Light is operated only when "MARKER" switch on control panel at right of driver is in "on" position.

Light circuit is protected by number 10 circuit breaker on lower panel at left of driver.

To replace bulb in light, remove cover from two rear reading lights at each end of reading light panel. Pull panel from body, then pull light socket and bulb from panel.

Electrical Specifications

WIRING AND MISC. ELEC.

CIRCUIT BREAKERS

Make	F.A. Smith Mfg. Co.
Type	Automatic Reset
Capacity (Amps.)	Refer to figures 6 & 8

RELAYS

(Refer to Table on page 150 for Relay Usage)

1116797

Make	Delco-Remy
Air Gap (points closed)	0.012"
Point Opening	0.020"
Closing Voltage Range	7.0-9.0

1116818

Make	Delco-Remy
Air Gap (points closed)	0.022"
Point Opening	0.030"
Closing Voltage Range	6.0-8.0
Sealing Voltage	11.0 Max.

1116845

Make	Delco-Remy
Air Gap (armature down)	0.012"
Point Opening (armature down)	0.020"
Closing Voltage	6.0 Min.
Opening Voltage Range	9.0-10.6

1116852

Make	Delco-Remy
Air Gap (points closed)	0.022"
Point Opening	0.030"
Closing Voltage	7.0 Min.
Sealing Voltage	9.0 Max.

1116901

Make	Delco-Remy
Air Gap (points closed)	0.012"
Point Opening	0.012"
Closing Voltage Range	12.3-13.2

1850547

Make	Delco-Remy
Model	268-H
Air Gap (points closed)	0.015"
Point Opening	0.020"
Closing Current (Amps.)	2.35 Max.
Opening Current (Amps.)	1.5 Min.

MAGNETIC SWITCHES

(Reading & Gen'l. Lighting, and Blower)

Make	Essex Wire Corp.
Type	70-111224
Voltage	12

ALARM BUZZER AND RECTIFIER ASSEMBLY

Make	Delco-Remy
Model	1116912
Point Opening	0.015"
Adjust to Buzz at	0.30-0.35 amps. at 13.5-14.5 volts.

LAVATORY EMERGENCY OR HAND BRAKE ALARM BUZZER

Make	Delco-Remy
Model	1116882
Point Opening	0.017
Adjust to Buzz at	0.25-0.35 amps. at 13.5-14.5 volts

HORN

Make	Delco-Remy
Model	1999700
Voltage	12
Air Gap	0.030"-0.034"
Current	3.5-5.5 amps.
Frequency	300-320

SPEEDOMETER

Make	AC Spark Plug Div.
Model	1582532

SPEEDOMETER DRIVE UNIT

Make	AC Spark Plug Div.
Model	1580967

STARTER SOLENOID

Make		Delco-Remy
Model	1118171	1119805
Current Consumption (@ 80°F.)		
Both Windings		
Amperes	49.0 - 55.0	44.0 - 50.0
Volts	10	12
Hold-In Winding		
Amperes	11.0 - 13.0	14.1 - 15.0
Volts	10	12

ELECTRICAL SPECIFICATIONS

BATTERY

Make	Delco-Remy
Model (Std. Equipment)	1980770 (8DR205-W-C3)
Quantity	two, connected parallel
Voltage	12
Plates per cell	27
Ampere hour capacity @ 20 hr. rate	205
Cranking ability at 0^{o}F.	10.5 Min. @ 300 amp.

STARTING MOTOR

	Early Models	Late Models
Make	Delco-Remy	Delco-Remy
Model	1108827	1114006
Rotation (viewed at drive end)	Counterclockwise	Counterclockwise
Brush Spring Tension	36-40 oz.	35 oz. Min.
No-Load Test		
Maximum Amps.	115	105
Volts	11.6	11.5
Approximate rpm	7000	6000
Lock Test		
Maximum Amps.	570	600
Volts	2.3	2.3
Torque (Minimum)	20 ft.-lbs.	19 ft.-lbs.

GENERATOR

Make	Delco-Remy
Model	1117604
Rotation (viewed at drive end)	Counterclockwise
Brush Spring Tension	20 oz.
Field Current Draw at 12 Volts (@ 80^{o}F.)	6.0-6.85 amps.
Cold Output	
Amperes	160
Volts	13
Approximate rpm	1225
Hot Output	Controlled by current regulator

REGULATOR

Make	Delco-Remy
Model	1118416
Type	Carbon Pile
Actuating Relay	
Top Air Gap (points just touching)	0.035"-0.042"
Back Air Gap (armature sealed)	0.016"-0.024"
Point Opening	0.024"-0.031"
Closing Voltage	
Range	12.2-13.3 volts
Adjust to	12.8
Circuit Breaker Relay	
Top Air Gap (points just touching)	0.034"-0.041"
Back Air Gap (armature sealed)	0.008"-0.017"
Point Opening	0.038"-0.052"
Closing Voltage	6.5-8.5 volts
Sealing Voltage	11.0 volts maximum but at least 1.0 volt above closing voltage

REGULATOR (Cont'd.)

VOLTAGE REGULATOR
Back Air Gap (armature loaded and parallel to core and frame) . . . . 0.015"-0.019"
Front Air Gap (with unit operating) . . . . 0.021" on one side
0.021"-0.029" on other side
Voltage Setting
Range . . . . 13.9-14.7 volts
Adjust to . . . . 14.3 volts

CURRENT REGULATOR
Back Air Gap (armature loaded and parallel to core and frame) . . . . 0.015"-0.019"
Front Air Gap (with unit operating) . . . . 0.021" on one side
0.021"-0.029" on other side
Current Setting
Range . . . . 150-165 amps.
Adjust to . . . . 160 amps.

OVERLOAD RELAY
Point Opening . . . . 0.013"-0.021"
Reverse Current
Range (@ 10-12 volts) . . . . 180-235 amps.
Adjust to . . . . 200 amps.

LIGHT BULBS

(All Bulbs Are Single Contact Except Destination Sign Bulbs.)

Quantity		Trade No.	Candle-Power
2	Headlight (Sealed Beam)	5440	40-50 Watt
6	Gauge Panel	67	3
2	Rear License Plate	89	6
2	Front Corner Marker	89	6
2	Rear Corner Marker	89	6
6	Michigan Marker	67	3
3	Front Destination Sign	90	6
11	Tell-tale Lights and Switch Bulbs . .	57	2
1	Emergency Door	53	1
6	Seat Lights (Special)	57	2
1	Front Step Light	1141	21
2	Taillights	67	3
5	Baggage Compartments	93	15
3	Engine Compartment	93	15
1	Air Conditioning Engine Compartment	93	15
1	Driver's Light	93	15
2	Night Light	67M	3
2	Fog Lights	1011	32
1	Spot Light	1141	21
2	Front Directional Lights	1141	21
2	Stop Light and Rear Direct	1141	21
40	Reading Lights	93J	15
24	General Lights	93J	15
1	Lounge Seat Reading Lamp	93J	15
1	Freon Receiver Tank Bulb	93	15

Keep All Connections Clean and Tight. A Clean and Tight Connection is a Good Connection.

When Making Electrical Connections, Always Refer To Wiring Diagrams to Make Sure of Proper Connections.

The Battery is The Heart of The Electrical System; It must be serviced at regular intervals to assure trouble-free operation of all electrical units.

Diesel Engine

Refer to current Diesel Engine Maintenance Manual for complete operation, maintenance, and repair information on engine and accessories.

Engine is GM Series 71, two cycle, six cylinder Diesel. Description and maintenance of engine accessories not included in Diesel Engine Maintenance Manual are included in this manual. Also included is the procedure for replacing the complete power plant assembly. Refer to ELECTRICAL SYSTEM (SEC. 7) for information on wiring and electrical units such as generator and starter. Maintenance of cooling system units is covered in COOLING SYSTEM (SEC. 6). Recommendations regarding fuel, and fuel system maintenance are given in FUEL SYSTEM (SEC. 12). LUBRICATION (SEC. 13) in this manual provides information necessary to proper servicing of oil strainer and filter as well as recommended lubricating oil.

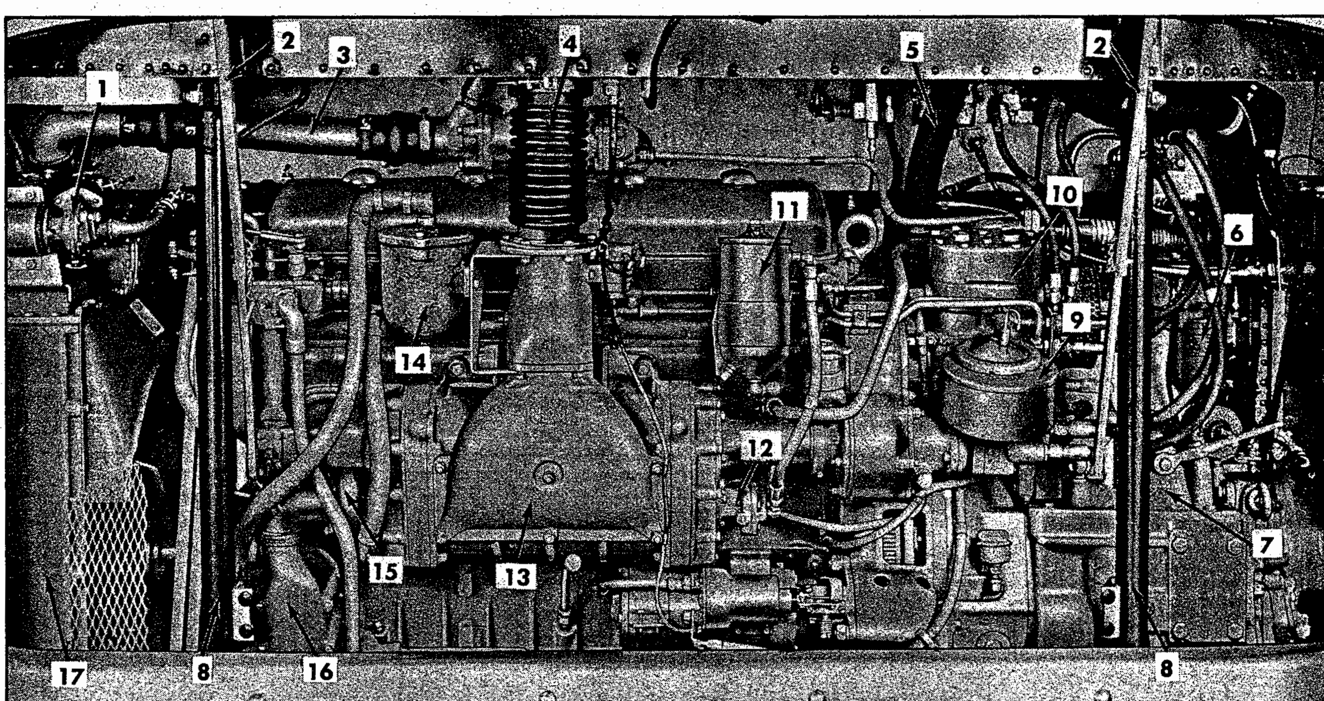
Engine general data is given at end of this section.

DIESEL ENGINE ACCESSORIES

Accessories described in this section are used either as regular or special equipment and are not included in the current Diesel Engine Maintenance Manual or in other sections of this manual.

OIL PRESSURE GAUGES

A conventional type oil pressure gauge is mounted in engine compartment for use when work-



1 Booster Water Pump	6 Fuel Oil Filter - Primary	12 Fuel Oil Pump
2 Door Support	7 Transmission	13 Blower Assembly
3 Water Pipe	8 Engine Cradle Support	14 Water Filter
4 Air Intake Hose (Air Cleaners to Blower)	9 Power Steering Fluid Pump	15 Water Pump
5 Generator Ventilation Hose	10 Air Compressor	16 Oil Cooler
	11 Fuel Oil Filter - Secondary	17 Radiator Assembly

Figure 1—Engine and Accessories Installed

ing on engine. The registering gauge at instrument panel is electric type interconnected with sending unit in manifold in engine compartment. When control switch is in "STOP" position the oil pressure gauge system is inoperative. Refer to "Alarm and Signal" wiring diagram in back of manual for wiring circuit.

TESTS

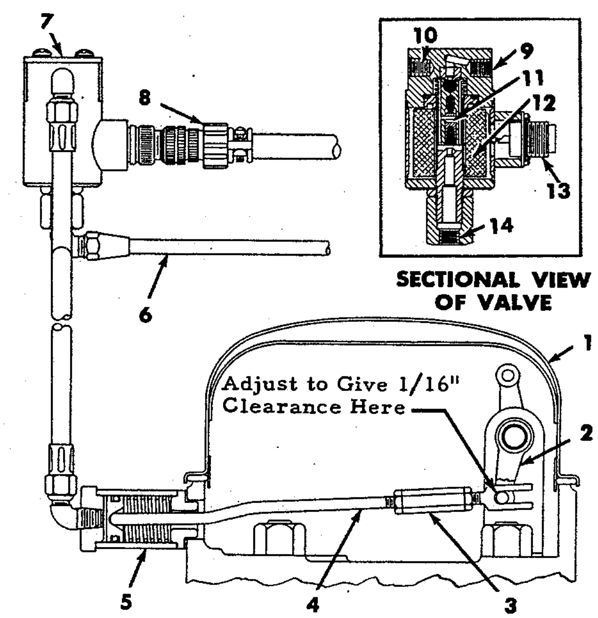
If oil pressure gauge does not operate, or shows questionable readings with control switch in "RUN" position, check system as follows:

1. Disconnect wire from engine unit and connect a test lamp of not more than 2 C.P. between battery terminal of starter solenoid and body of the unit. If lamp fails to light the unit is not grounded and the threaded hole and the threads on the unit should be checked for metal to metal contact. If the lamp lights the unit can be considered grounded. (DO NOT USE A LAMP OF OVER 2 C.P.)

2. Remove the wire from the unit terminal and connect the test lamp between the unit terminal and the battery post on the starter solenoid. If lamp lights, start engine and observe if lamp changes intensity. A satisfactory unit will change the lamp intensity at different engine speeds. (Changes in oil pressure)

3. Replace the wire and check wiring for open circuit between unit and gauge on instrument panel. If this circuit checks satisfactorily check with test lamp between the gauge resistor and ground, lamp should light on both sides of the resistor. If lamp lights only on the feed side, the resistor is open.

4. If units pass above tests replace the gauge and check for operation at various engine speeds.



1 Cylinder Head Cover
2 Injector Control Tube Lever
3 Push Rod Coupling
4 Push Rod
5 Air Cylinder
6 Air Supply Line
7 Control Valve
8 Wiring Connector
9 Air Exhaust Port
10 Air Line to Cylinder
11 Valve Plunger
12 Coil
13 Electrical Connection
14 Air Inlet

TP-9080

Figure 2—Air Operated Engine Shut-Off

LOW OIL PRESSURE SWITCH

Low oil pressure electrical switch is installed in oil pressure sending manifold, which is mounted on engine compartment bulkhead near surge tank. Manifold is connected with engine oiling system by a flexible tube.

When engine is running, the oil pressure acts upon a diaphragm to hold a pair of switch contacts open. However, if pressure should drop below 3 to 4 lbs., points will close completing circuit. When points close, telltale alarm buzzer sounds, and low oil telltale light illuminates. Whenever alarm buzzer sounds or low oil telltale lights, stop engine immediately and correct cause of low pressure.

CIRCUIT TEST

Low oil pressure indicating system is interconnected with control switch so that system is inoperative when control switch is off.

With control switch in "RUN" position, and engine not running, low oil pressure telltale light should be illuminated and buzzer should sound. If buzzer sounds and light does not illuminate, replace bulb. If light is illuminated and buzzer does not sound, check telltale alarm buzzer.

If light fails to illuminate and buzzer fails to sound with control switch in "RUN" position, momentarily connect the two wire terminals at pressure switch. Failure of telltale lights or buzzer to sound indicates that the circuit to these units is at fault. Refer to Alarm and Signal wiring diagram in back of manual for electrical circuit.

SOLENOIDS

Engine is equipped with an emergency stop solenoid mounted on blower air intake housing. Refer to applicable operator's manual for use of emergency stop control and refer to WIRING DIAGRAM in back of manual for electrical circuits.

AIR-OPERATED INJECTOR SHUT-OFF

An air-operated injector rack shut-off is used to stop the engine when control switch is turned to "STOP" position. Air supply to shut-off cylinder is controlled by magnet type valve mounted in engine compartment. Figure 2 shows schematic arrangement of control valve, air cylinder and air lines. Air cylinder assembly is mounted on cylinder head, and an adjustable push rod transmits piston movement to lever at end of injector control tube.

OPERATION

When engine control switch is in "RUN" position, air pressure is exhausted from air cylinder permitting injector racks to be moved to "full fuel" position for normal operation. When control switch is turned off, air is admitted to air cylinder and piston moves to end of travel thereby forcing injector racks to "no-fuel" position causing engine to stop. Air is applied to cylinder during the time control switch remains in off position.

NOTE: On vehicles equipped with Moto-Gard system the electrical circuits are so connected, that engine is automatically stopped in case of low oil pressure or in case of overheated engine. Refer to "Moto-Gard" in ELECTRICAL SYSTEM (SEC. 7) in this manual.

MAINTENANCE

The only maintenance normally required at shut-off mechanism is a periodical check of push rod adjustment and check of air line connections.

AIR CYLINDER PUSH ROD ADJUSTMENT (Fig. 2)

1. Check air cylinder mounting bolts which must be tight.
2. Remove cylinder head cover and check for clearance between push rod and cylinder head stud nut. If any interference exists, loosen lock nut, turn rod as necessary to obtain clearance between rod and nut.
3. With engine stopped and control switch in "RUN" position, hold injector control tube in "full-fuel" position and check for clearance between pin and throat of rod yoke. If necessary, turn rod end coupling to provide 1/16" clearance, then tighten lock nuts.
4. Turn control switch off. If there is presure in air system, piston will move inward to end of travel and push injector racks to "no-fuel" position.

With air cylinder in this position, pin (fig. 2) should not bind on yoke and end of yoke must not touch cylinder head.

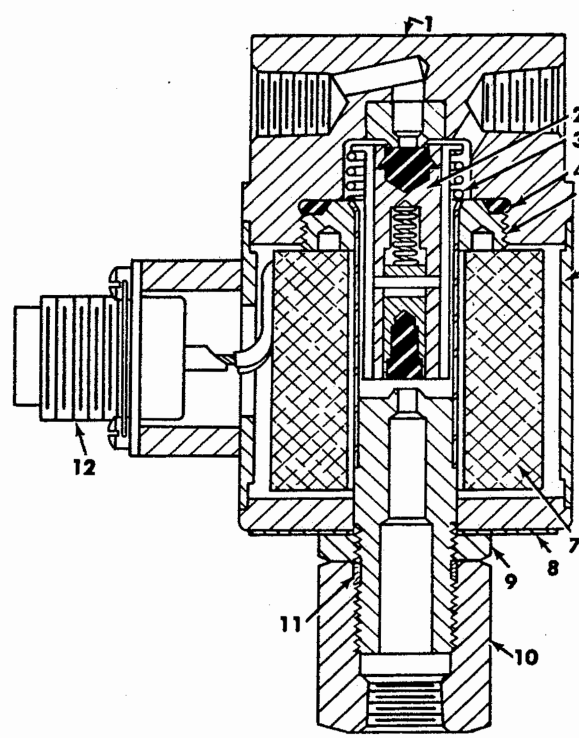
MAGNET VALVE

Magnet valve shown in figure 3 can be disassembled for cleaning and inspection. Plunger, spring, and seals are available for service replacement.

Disassembly

1. Remove threaded connector (10) and seal (11) from bottom of valve assembly, then remove thin nut (9) which holds housing and coil assembly to sleeve assembly (5).
2. Remove housing and coil assembly by sliding off lower end of sleeve assembly.
3. Using spanner wrench (Skinner #VO-233) remove sleeve, plunger, and spring (5, 2 and 3) from valve body (1).
4. Separate plunger and spring from sleeve and remove seal (4) from valve body.

NOTE: Seals (4 and 11) should be discarded and new seals obtained for use when assembling valve.



1 Valve Body	7 Coil
2 Plunger Assembly	8 Name Plate
3 Spring	9 Sleeve Nut
4 Sleeve Seal	10 Connector (Air Inlet)
5 Sleeve Assembly	11 Connector Seal
6 Housing	12 Wiring Connector

TP-9079

Figure 3—Engine Shut-Off Magnet Valve

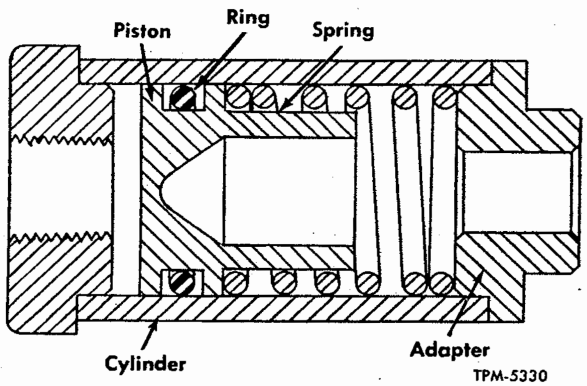


Figure 4—Engine Shut-Off Air Cylinder

Assembly

Examine valve seats and mating surfaces and check condition of spring. Obtain new parts as required and follow directions below to assemble.

1. Assemble spring (3) on plunger (2) then insert plunger into sleeve assembly (5).
2. Place new seal (4) in valve body then screw sleeve into body using spanner wrench.
3. Assemble housing and coil assembly over sleeve, then install name plate (8) and sleeve nut (9).
4. Place new seal (11) in groove in sleeve, then install connector (10) and tighten while holding nut (9).

CAUTION: Overtightening nut (9) will put excessive stress on sleeve; tighten nut only as necessary to seat parts solidly.

SHUT-OFF AIR CYLINDER

Engine shut-off air cylinder (fig. 4) is mounted at cylinder head as shown in figure 2.

Disassembly

1. Disconnect air line from end of air cylinder.
2. Remove two bolts attaching air cylinder to cylinder head, then remove air cylinder assembly.
3. Remove adapter from end of cylinder, then remove spring and piston with ring.
4. Remove piston ring from piston, then discard ring.

Cleaning and Inspection

1. Wash all parts thoroughly in solvent and wipe dry
2. Examine all parts thoroughly for evidence of damage or excessive wear. Inspect cylinder walls for scoring. Replace parts not in good condition.

Assembly

During assembly apply a liberal coating of engine oil to all internal parts.

1. Install new ring on piston, then install piston into cylinder with flat side of piston toward outer end of cylinder.
2. Install spring in cylinder, then position adapter at end of cylinder.
3. Install new gasket over adapter, then locate assembly on cylinder head. Secure assembly to cylinder head with two bolts.
4. Adjust as directed previously under "Air Cylinder Push Rod Adjustment" in this section.

ENGINE REPLACEMENT

ENGINE MOUNTING

Power plant including engine, clutch, and transmission is mounted on engine cradle and the complete assembly is installed transversely at rear of vehicle (fig. 1). Brackets (fig. 7), at lower edge of engine compartment bulkhead support engine cradle at forward side, while cradle is supported at rear by two tube and plate assemblies (fig. 1) suspended from support beam at rear of coach. Power plant including radiator and exhaust system is removable as an assembly.

Three rubber type mounting assemblies support engine on cradle. A single trunnion type mounting (fig. 5) supports front end of engine at balance weight cover. At rear of engine two mountings are used one at each side of flywheel housing. Power plant is held in position on mountings by stabilizer rods (fig. 6) which anchor the power plant assembly to cradle. Power plant and accessories are accessible for minor service operations through rear and right engine compartment doors. The complete power plant assembly may be removed as a unit, or the transmission and clutch may be removed for service operations with engine remaining in place in coach. Refer to TRANSMISSION (SEC. 17) or CLUTCH (SEC. 5) for procedures to remove above units.

REMOVING POWER PLANT

Engine compartment switch panel, accessible through rear compartment door, contains starter button, starter circuit cut-out switch, and engine compartment light switch. Always shut off starter circuit cut-out switch before working on engine. This prevents accidental starting of engine with starter button, while working on engine.

Power plant, including transmission and radiator, may be removed from vehicle in following

manner: Procedures outlined are in sequence and should be followed in order.

NOTE: Before proceeding with operations as listed, disconnect both battery leads from batteries. Also open drain cock in main air system tank to exhaust air from main system. One tank is located between bulkheads at left side behind rear wheels.

1. Raise and support engine compartment door, then remove door support arms at engine support tubes.

2. Remove radiator closure door in front of radiator shutter.

3. Remove transmission and engine dust shields, and remove right and left bumper extensions.

4. Drain cooling system. Two drain cocks must be opened; one at water pump and one under forward radiator water outlet line. Shut-off valves in heater lines may be closed so it will not be necessary to wait for water to drain from heating system.

5. Disconnect heater pipes between engine and bulkhead. Remove cooling system hoses between radiator and surge tank and between engine and surge tank; air intake hose between blower and manifold, also disconnect ventilator hose from generator.

6. Remove bolt and rubber insulators attaching top of radiator to upper bracket.

7. Disconnect discharge line and governor line from air compressor. Disconnect air lines from shutter thermostat, shutter air cylinder, and from engine shut-off air cylinder.

8. Disconnect oil pressure gauge line at front of cylinder head cover.

9. Disconnect wiring harness at connector at engine compartment behind air cleaners. Also disconnect wires from engine temperature sending unit and from engine overheat thermostat. These two units are installed in water manifold on top of engine.

10. Disconnect wires from reverse solenoid, from generator, and from electric speedometer unit.

11. Disconnect fuel lines.

12. Disconnect throttle control at front of engine and disconnect hand brake rod. Unhook springs and disconnect transmission shift rods, and clutch control rod.

13. Disconnect ground straps at bulkhead side of engine and disconnect cable from junction under flap at bulkhead. If vehicle is equipped with power steering, disconnect hydraulic lines from pump at engine.

SAFETY CAUTION

Before proceeding with step 14 below, block coach body securely. When adjusting dolly to take weight of power plant, the coach body may be inadvertantly raised just enough to cause height control valve to exhaust in which case entire weight of rear end of coach will be placed on dolly.

14. Position engine dolly under cradle and adjust to take weight off support tubes, then remove bolts at upper end of each support tube and remove bracket caps at front of cradle.

15. Loosen dust cap on propeller shaft to allow splined end to be disengaged from slip yoke,

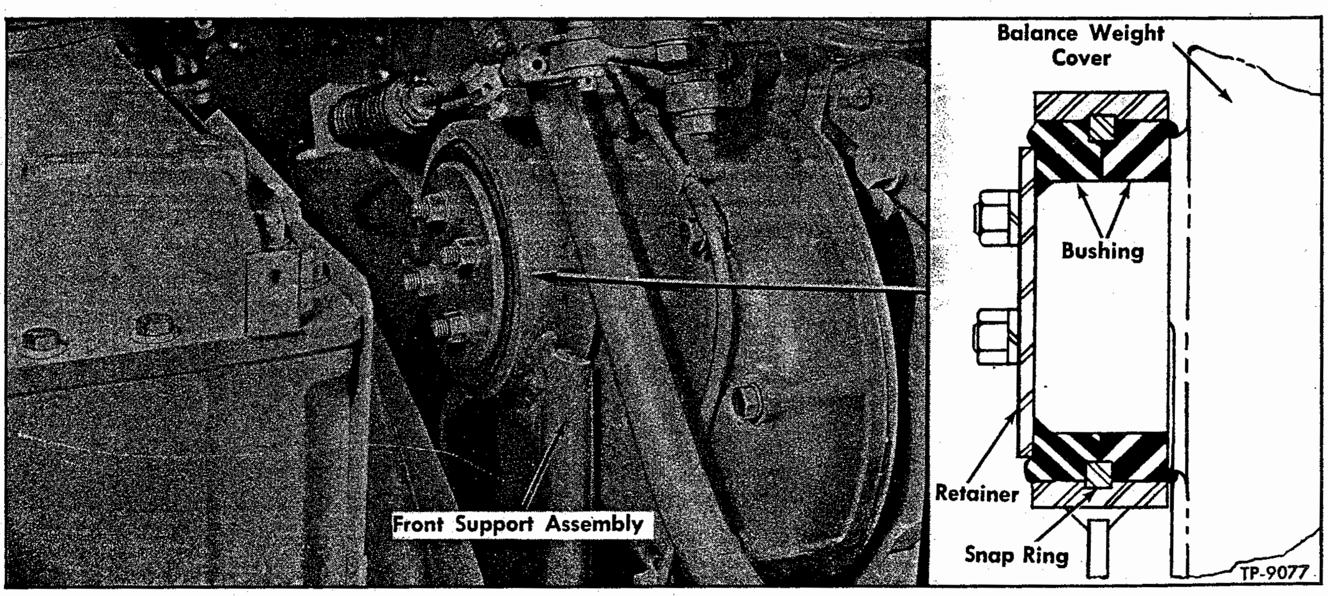


Figure 5—Engine Front Mounting

DIESEL ENGINE

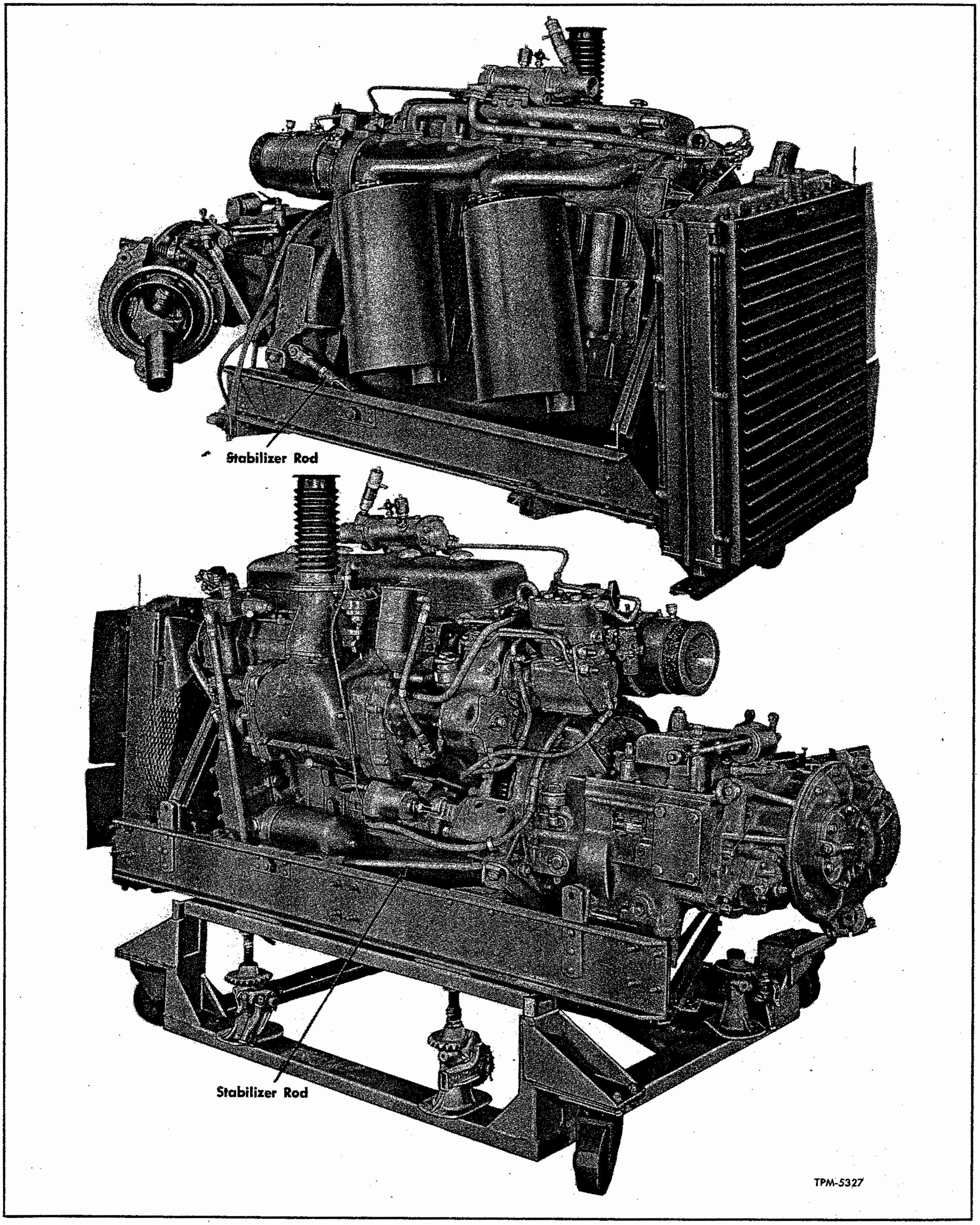


Figure 6—Power Plant Removed

then move power plant away from coach.

16. Radiator and shutter assembly, and transmission assembly may be removed by following the pertinent instructions in COOLING SYSTEM (SEC. 6) and TRANSMISSION (SEC. 17). Diesel engine may be lifted off cradle using lifting brackets provided at cylinder head.

ENGINE CRADLE AND MOUNTING INSPECTION

Engine Cradle and Brackets at Bulkhead (Fig. 7)

1. Carefully inspect balls (11) and bolts (9) at brackets on bulkhead for evidence of wear. Replace worn parts.

2. Inspect cradle brackets and engine support members for wear and for fractures and make necessary repairs.

Engine Mountings

1. Inspect engine front mounting bushings (fig. 5). If bushings are deteriorated or damaged replace bushings.

2. Inspect engine rear mounting assemblies. If mountings are oil-soaked or show evidence of failure, replace mountings.

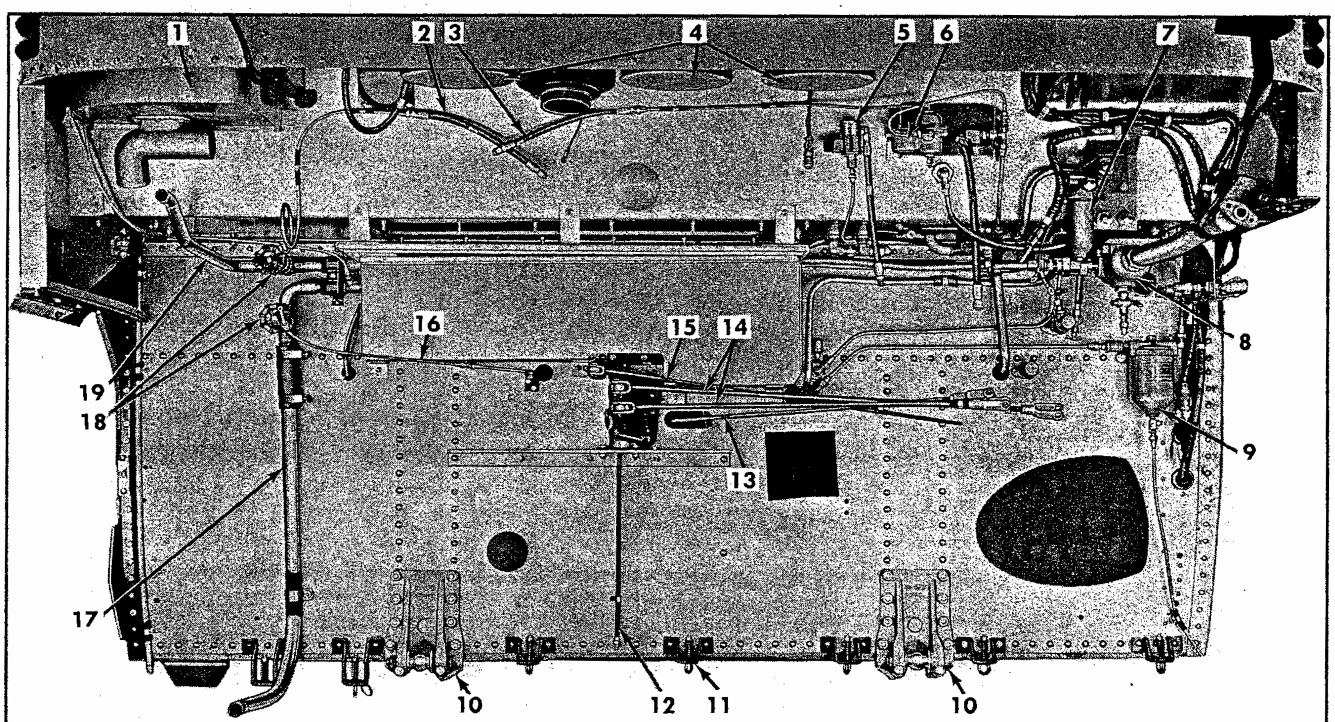
3. IMPORTANT: When inspecting engine cradle and brackets and when assembling balls and bolts at brackets on bulkhead accomplish the following procedure before installing power plant assembly:

a. Firmly tighten nut on bolt at right support (10), also tighten bracket clamp bolts.

b. At left support (10) loosen clamp bolts to permit ball and bolt assembly to shift endwise in bracket. Clamp bolts must remain loose until weight of power plant rests on brackets.

INSTALLING POWER PLANT
(Refer to Figure 7)

Make necessary repairs to exhaust system units before installing power plant. Fan, radiator and shutter assembly, and clutch and transmission should be assembled to engine as well as hand brake mechanism and universal joint, since attaching parts are readily accessible with power plant removed. Refer to applicable section in this



1 Cooling System Surge Tank
2 Air Line - Thermostat to Air Cylinder
3 Air Line - Air Filter to Thermostat
4 Air Cleaners
5 Engine Stop Magnet Valve
6 Radiator Shutter Air Filter
7 Power Steering Fluid Filter
8 Compressor Discharge Muffler
9 Fuel Primary Filter
10 Engine Cradle Support
11 Engine Pan Hangers
12 Lubrication Fitting
13 Hand Brake Control Rod
14 Transmission Control Rods
15 Clutch Control Rod
16 Accelerator Control Cable
17 Heater Pipe
18 Heater Pipe Shut-off Valves
19 Heater Pipe

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Figure 7—Cradle Support Brackets and Controls at Bulkhead

manual for details and procedure for installing engine accessories.

The steps listed below should be followed in the order given to install power plant.

1. Move power plant assembly into position, meanwhile guiding propeller shaft yoke onto propeller shaft splines.

NOTE: Propeller shaft yokes must be aligned as explained in PROPELLER SHAFT (SEC. 18).

2. Lower the power plant into position with brackets at front side of cradle engaging brackets at lower edge of engine compartment bulkhead (fig. 7).

3. At rear side of power plant, install support tubes and bolt in place. Remove dolly from under cradle.

4. With weight of power plant resting on brackets (fig. 7), use lead hammer to strike bolt and thereby positively locate ball in spherical seat in bracket.

5. Install caps at support brackets (fig. 7) at front of cradle, and tighten cap bolts firmly. Use lock wires to secure bolts. At left support bracket, tighten bracket clamp bolts and tighten nut on bolt (10).

6. Screw dust cap into place at propeller shaft slip joint. Connect cable at junction terminal on bulkhead and attach ground straps to engine.

7. Connect control rods to levers at transmission. Hook up clutch and hand brake return springs. Connect hand brake control rod at lever. Connect and adjust clutch control rod. Refer to CLUTCH (SEC. 5) for information on clutch control linkage.

8. Attach throttle control bracket at front of engine and connect throttle control to bell crank.

9. Install bolt and rubber insulators which attach radiator assembly to upper support.

10. Install hoses between surge tank and radiator and between surge tank water manifold. Also connect heater lines.

11. Install shutter thermostat and connect air lines, also connect air line to radiator shutter air cylinder. (Diaphragm type unit is used on some installations.)

12. Connect air line at engine shut-off air cylinder.

13. Connect air compressor discharge line and air compressor governor line.

14. Connect fuel lines and engine oil pressure line. If vehicle has power steering, connect hydraulic fluid lines to pump on engine.

15. Connect blower air intake hose at air cleaner manifold and connect ventilator hose at generator.

16. If temperature sending unit and overheat thermostat have been removed, install these units in water manifold. Connect wires to latter two units.

17. Connect wiring harness at connector at top of engine compartment behind air cleaner manifold. Also attach wiring at reverse solenoid and at speedometer unit on transmission. Connect wires to terminals at generator. Attach door support arms at brackets on engine support tubes.

18. Fill cooling system and open valves in heater lines. Refer to COOLING SYSTEM (SEC. 6) for complete instructions for filling cooling system.

19. Fill engine crankcase and transmission referring to LUBRICATION (SEC. 13) for type and quantity of lubricant required.

20. Install rear bumper, and bumper extensions. Install dust shields under engine and transmission. Install closure door at front of radiator shutter.

21. Connect battery cables. Start engine and make necessary inspections to assure proper operation of controls, gauges etc.

22. Inspect all connections in oil lines, fuel lines, air connections, and cooling system for leaks.

SPECIFICATIONS

ENGINE	
Model	6-71LA47
Bore	4-1/4"
Stroke	5"
Total Displacement - Cu. In.	425.6
Engine Rotation	Counterclockwise
Firing Order	1-4-2-6-3-5
Engine Governed Speed (No Load)	2125 to 2150 rpm
LOW OIL PRESSURE SWITCH	
Make	AC
Model	1508391
Contacts Break (Lbs. Pressure)	2-4
OIL PRESSURE GAUGE ON INSTRUMENT PANEL	
Make	AC
Type	G
Gauge Unit No.	1508022
Engine Unit No.	1508392
Voltage	6 volts with 12V adapter
Range	0-80 Lbs.

EMERGENCY STOP SOLENOID	
Make	Delco-Remy
Model	001424
Voltage	12
Current Consumption @ 80°F.	12-13 Amps.
INJECTOR AIR SHUT-OFF MAGNET VALVE	
Make	Skinner Chuck Co.
Model	V5-2220
Magnet Valve Spring	
Pressure @ 3/16" Height	4-1/2 to 5-1/2 oz.
Engine Shut-off Air Cylinder	
Piston Diameter	0.997"-0.998"
Return Spring	
Free Length	1-5/16"
Lbs. Pressure @ 1.000"	9-13
Cylinder Diameter	0.9995"-1.0015"

Fuel System

Fuel system units covered in this section include; fuel tank, lines, and filter; accelerator pedal and linkage; air cleaners; and system specifications. Other items, such as; injectors, engine governor, fuel pump, and blower are covered in current Diesel Engine Maintenance Manual. Approved specifications for Diesel fuel oil will be furnished upon receipt of request.

FUEL TANK AND LINES

Schematic layout of fuel tank, lines and filters is shown in figure 1. Tank is installed in compartment at right side of coach and is equipped with a signaling device which emits a whistling sound as tank is filled. A ball type check valve is used in whistle tube and is so positioned that fuel cannot escape through whistle tube in case vehicle is upset. Two fuel lines run from tank to engine compartment at rear of coach. Pump at engine draws fuel through supply line and primary filter and discharges fuel through secondary filter and into fuel manifold at engine cylinder head. Surplus fuel is returned to tank through return line. Primary filter (fig. 5) is cleanable type while secondary filter (fig. 6) is renewable element type. Refer to "Fuel System Maintenance" later in this section for method of servicing. Check valve located at primary fuel filter inlet serves to keep supply line full of fuel while servicing filters, and when fuel lines are disconnected in engine compartment.

ACCELERATOR AND LINKAGE

Key Numbers Refer to Figure 2.

Accelerator pedal is connected to governor

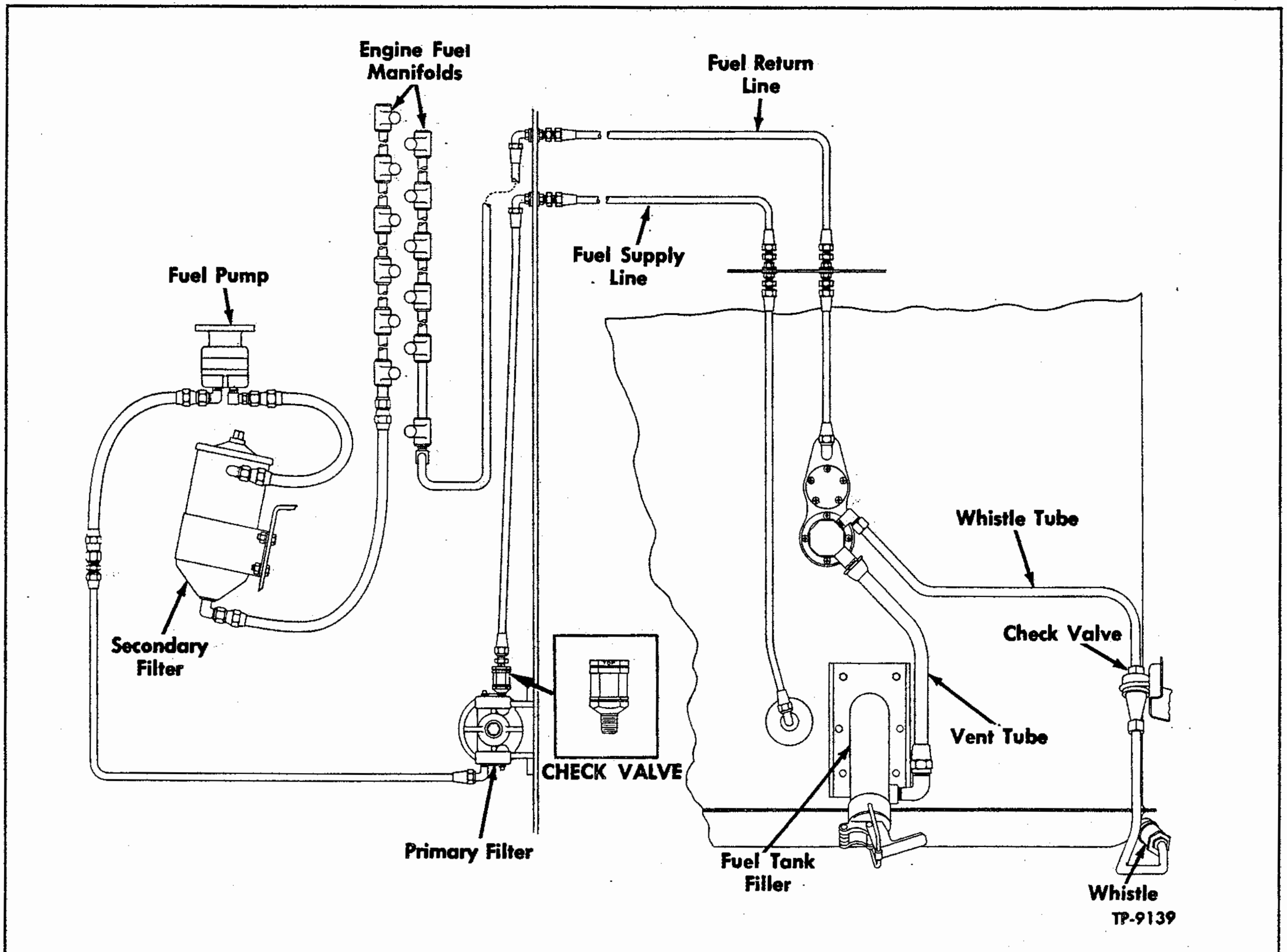
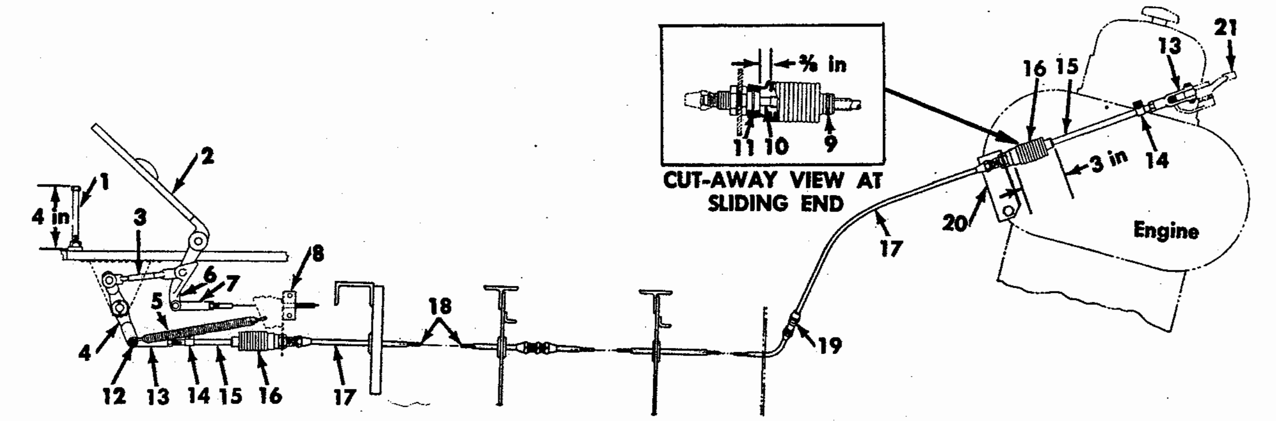


Figure 1—General Arrangement of Fuel Lines, Tank, and Associated Units

FUEL SYSTEM



1 Pedal Stop
2 Accelerator Pedal
3 Link
4 Idler Lever
5 Spring
6 Hand Throttle Lever
7 Clevis
8 Throttle Wire Housing Clamp
9 Boot Clamp
10 Sliding End Tube (Inner)
11 Swivel Assembly
12 Special Pin
13 Clevis
14 Cable Lock Clamp
15 Sliding End Tube (Outer)
16 Boot
17 Cable Conduit
18 Cable
19 Flexible Connector
20 Control Bracket
21 Bell Crank

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Figure 2—Accelerator Pedal and Linkage

lever at engine by rods, levers and flexible cable which is encased in metal tubing. Figure 2 shows construction of accelerator linkage.

Adjustable stop screw (1) in floor limits pedal travel. A bellows type boot (16) is used at cable sliding ends to exclude dust and dirt. Linkage at front end is accessible through compartment door at left front corner of coach; and rear end can be reached in engine compartment. Whenever cable is removed from conduit, it must be cleaned and lubricated. Hand throttle wire is attached to lever (6) at lower end of accelerator pedal (2).

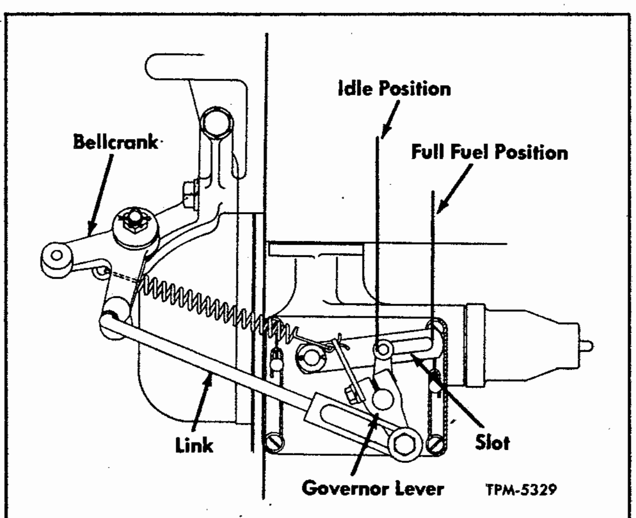


Figure 3—Accelerator Controls at Engine

ACCELERATOR LINKAGE REPLACEMENT
Key Numbers in Text Refer to Figure 2.

Removal

1. Unhook spring (5) in compartment at front end of linkage. Remove clevis pins to disconnect clevises (7 and 13) and to permit removal of lever (4), link (3), and pedal (2). NOTE: It is not often necessary to remove accelerator pedal, since wear on parts is slight and other linkage components can be removed without removing pedal.

2. Loosen cable lock clamp (14) and slide clamp endwise, remove lock from sliding end outer tube (15). Disengage boot (16) from groove at swivel assembly (11), then pull outer tube (15) forward with clevis (13) and boot attached and remove parts as an assembly.

3. In engine compartment, remove clevis pin attaching clevis (13) to bell crank (21). Disengage boot from groove in swivel assembly, then cable (18) may be pulled out of conduit with sliding end outer tube and boot attached to rear end. Removal of lock clamp (14) permits separation of cable from tube (15).

4. If inspection shows that conduit or flexible connector (19) requires replacement, the damaged section may be removed by separating conduit sections at connectors.

Cleaning and Inspection

1. Wash cable in suitable cleaning solvent to remove old lubricant.

2. Carefully examine cable for kinks and for broken strands. If any damage is evident, new cable must be installed. Overall length of cable is 410". Ends of new cable must be chamfered by grinding. To prevent frayed windings, grinding must be done only in direction of outer windings.

3. Inspect cable conduit for breaks, dents, and flat spots. Any condition which would prevent free movement of cable necessitates replacing damaged section of conduit.

CAUTION: When replacing conduit, make sure it is clean and that cable will pass through it freely. Use extreme care in installing conduit to prevent bending or flattening.

Installation and Adjustment

Swivels and surface of each sliding end must be lubricated as instructed in LUBRICATION (SEC. 13) when assembling accelerator control linkage, and lubricant as specified must be applied to cable as cable is fed into conduit.

Following steps must be performed in sequence as given to assure proper operation of linkage. Key numbers refer to figure 2 unless otherwise indicated.

1. Dip end of cable in lubricant as specified in LUBRICANT (SEC. 13), then feed cable into conduit, applying lubricant to cable as cable is installed. Continue to feed cable into conduit until cable emerges at front end of conduit. Test cable for free movement.

2. In engine compartment, slide boot (16) onto tube (15) and install tube (15) over inner tube (10). Attach rear clevis (13) to bell crank (21) with clevis pin. Try operating the bell crank to move governor lever (fig. 3) from idle to full fuel position. Linkage at governor (fig. 3) should move freely.

3. Hold bell crank so that stop pin is at end of slot in cam (fig. 3) at the full fuel position and note gap between end of outer tube (15) and swivel (11). If necessary loosen lock nut at clevis (13) and turn outer tube to adjust gap to 3/8" as shown in cutaway view in figure 2. Tighten lock nut when gap is as specified.

4. Slide boot into position in groove at swivel, then move other end of boot to provide 3" overall length as shown in figure 2 and install boot clamp (9).

5. Assemble cable lock and clamp (14) to attach cable to sliding end tube (15).

6. Adjust accelerator pedal stop screw (1) to 4" height shown in figure 2. Assemble hand throttle lever (6), link (3) lever (4), and sliding end assembly and adjust outer tube to swivel gap at 3/8" with pedal (2) contacting stop screw. Tighten lock nut at clevis (13) to lock adjustment and adjust boot length to 3 inches and clamp the boot in place.

7. While assistant holds bell crank (21) in engine compartment at full fuel position (pin at end of slot, fig. 3), assemble cable lock and clamp (14) at front end of linkage.

IMPORTANT: Above operation must be done with pedal held against stop screw.

8. Install spring (5), then connect hand throttle clevis (7) to lever (6).

9. Check operation of accelerator and hand throttle. Observe position of pin in cam lever slot at engine governor referring to figure 3. Slight readjustment at pedal stop screw and at hand throttle clamp may be necessary to allow full travel of pin to either end of slot.

AIR INTAKE SYSTEM

(Refer to Figure 4)

Air for engine is taken in at rear of coach through screened openings. One opening is provided at each rear corner above engine compartment. At left corner the air intake is through opening in surge tank filler door. Air passes through ducts to air cleaners. From air cleaners, air enters manifold to which is connected the blower intake. Arrows on figure 4 indicate direction of air flow. A tube is installed between generator and air duct and air is drawn from engine compartment through generator housing to cool the generator. Oil-wetted mesh type air cleaner at commutator end frame removes dirt from air as it enters generator.

AIR CLEANERS

Three heavy duty oil bath air cleaners mounted on air cleaner manifold are used to remove dust and dirt from air before it reaches blower on engine. Air cleaners are accessible from engine compartment after compartment rear door is raised. Refer to figure 4 for cross-section view of air cleaner. Refer to "Servicing Air Cleaners" under "Fuel System Maintenance" later in this section for method of servicing air cleaners.

FUEL SYSTEM MAINTENANCE

SERVICING FUEL FILTERS

Fuel oil filters are shown in figures 5 and 6. In order for these filters to function properly, they must be given proper care. Service in following manner:

Primary Filter (Cleanable Type)

Primary filter (fig. 5) must be drained frequently because if water is present in the fuel it is most likely to accumulate in this filter. No definite draining periods can be given here, inasmuch as the necessity for draining depends upon the cleanliness of the fuel put into the fuel tank. It is recommended, that a small amount of fuel oil be drained from this filter daily, noting the water

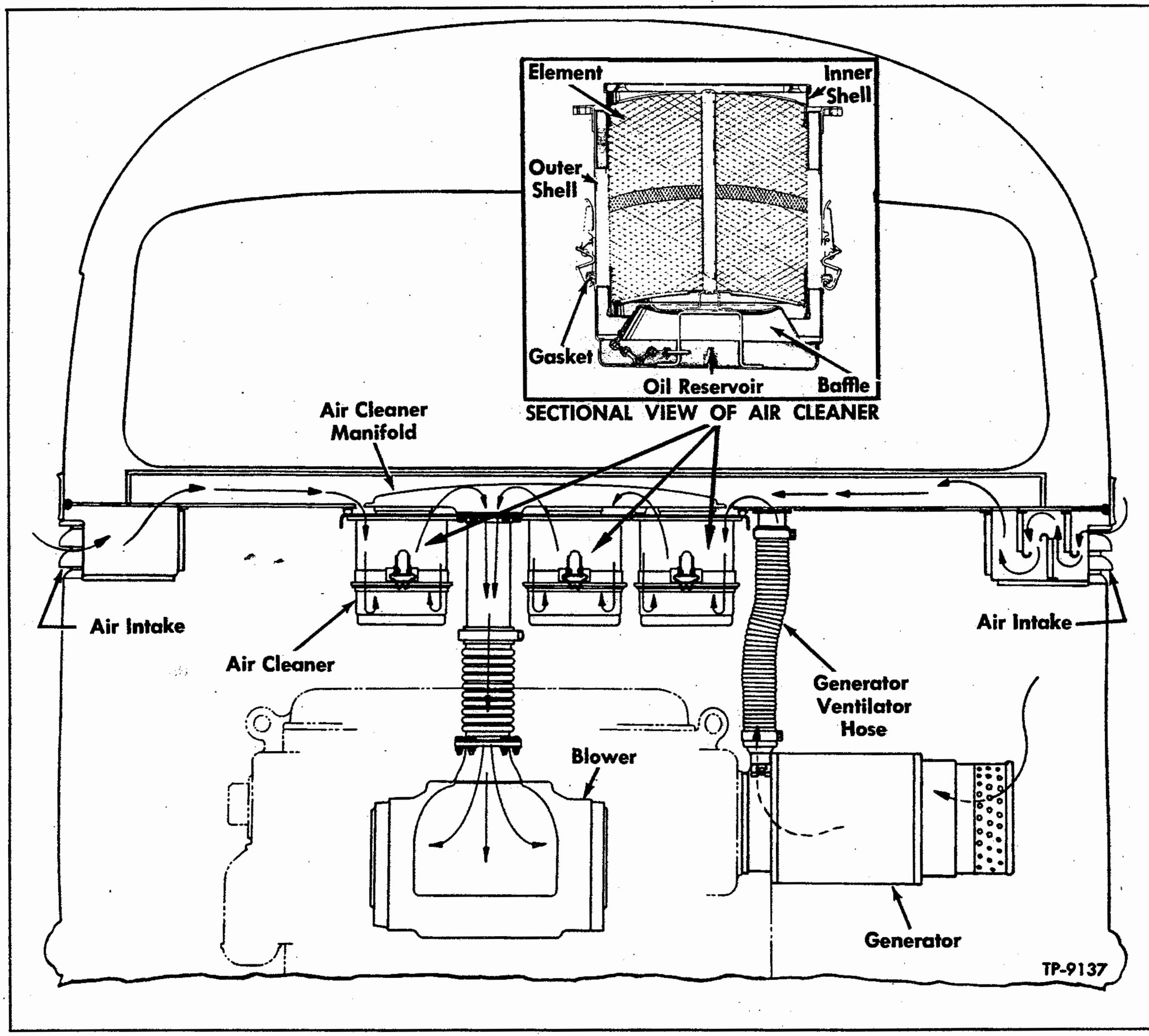


Figure 4—Air Intake System

content (if any), then from this experience definite draining periods may be established. Drain filter by opening drain cock at bottom of filter. If water in any amount is regularly found in this filter, it is an indication that something is wrong in the method of handling and storing of the fuel oil and a thorough investigation must be made to eliminate the trouble; then the fuel tank lines and both filters should be drained and cleaned. The only water that will normally accumulate in the fuel system is from condensation in the fuel tank.

Cleaning Primary Filter

In addition to periodic draining as described in preceding paragraph, filter should be thoroughly cleaned every 5,000 miles as follows:

1. Open drain cock at bottom of filter and allow filter to drain.
2. Remove bolt at top of filter and withdraw housing and edge-type filter element. Lift filter element out of housing.
3. Wash all filter parts, including element, in a suitable cleaning solvent. Be sure all particles are removed from between disks of element. Use air if necessary.
4. Inspect filter housing gasket, element gasket, and bolt gasket; replace if not in good condition.
5. Reassemble filter and inspect carefully for leaks. Be sure drain cock is closed tightly.

NOTE: In the event check valve (fig. 5) is removed from primary filter, always reinstall with word "TOP" facing upward.

Secondary Filter (Renewable Element Type)

It is recommended that secondary filter (fig. 6) be drained at same intervals as primary filter. Refer to "Primary Filter" in previous paragraph for intervals.

In addition to draining, the following check should be made at intervals of approximately 5000 miles to determine the condition of the element. This check may be made by disconnecting fuel line at bottom of the filter and installing a pressure gauge connected to a "tee." Start engine and note pressure on gauge. If the pressure reading is less than 15 lbs. at 2000 rpm, the element must be removed and replaced. Do not open the filter except at time of element replacement. Replacement usually will be required every 10,000 miles or 500 hours. DO NOT ATTEMPT TO CLEAN AND REINSTALL FILTER ELEMENT.

Replacing Secondary Filter Element

If periodic check, as described in previous paragraph, indicates filter element should be changed, proceed in following manner:

1. Remove drain plug from filter housing and allow filter to drain.
2. Loosen cover nut, then lift cover and gasket from filter housing.
3. Lift element from filter housing and discard element.
4. Wash all filter parts with a suitable solvent.
5. Install new element in housing and install cover, using a new gasket between cover and housing. Tighten cover nut and drain plug.
6. CAUTION: After element has been replaced as instructed above, loosen, but do not remove the square headed plug at top of filter for air vent. Loosen it just enough to allow air to escape. THEN, run the engine until fuel oil comes out of this vent in a solid stream. Check the filter connections and oil lines for leaks and tighten if necessary.

SERVICING AIR CLEANERS AND AIR INTAKE SCREENS (Fig. 4)

Importance of keeping air cleaners in proper condition should be impressed on those responsible for mechanical upkeep of engine.

Unless air cleaners are cleaned periodically as service conditions require, they will not function properly, and in some instances, actually aggravate the condition which they are designed to prevent.

When air cleaner is loaded and dirty, and is used past its saturation point, some of this fine abrasive will get past cleaner and cause considerable damage to pistons, cylinder walls, and bearings

For those reasons, air cleaners must be cleaned at regular intervals at least every 1,500 miles, or more often if conditions warrant. Under adverse conditions or extensive operation on dusty or sandy roads, units should be cleaned every day

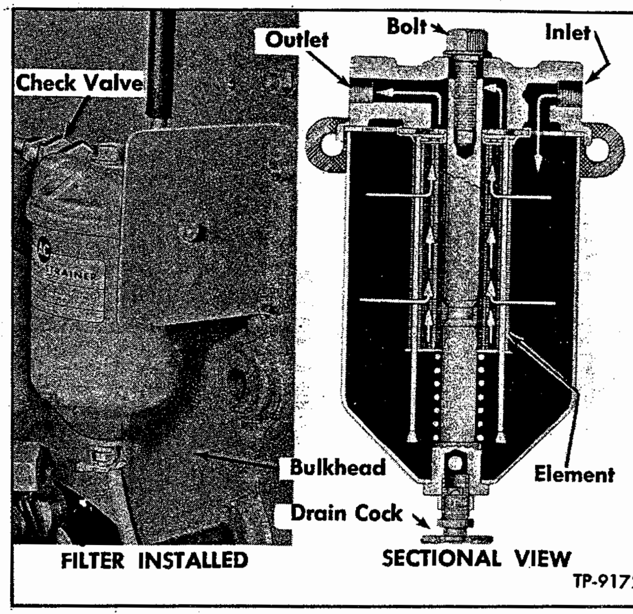


Figure 5—Fuel Oil Primary Filter

or at least every 200 miles.

Air cleaners on vehicles operating in dust storm areas should be cleaned immediately after such storms occur.

Refer to LUBRICATION (SEC. 13) for instructions for servicing blower and air cleaners.

Periodic inspection should be made at air intake openings to determine if screens have become clogged. An access plate attached by screws can

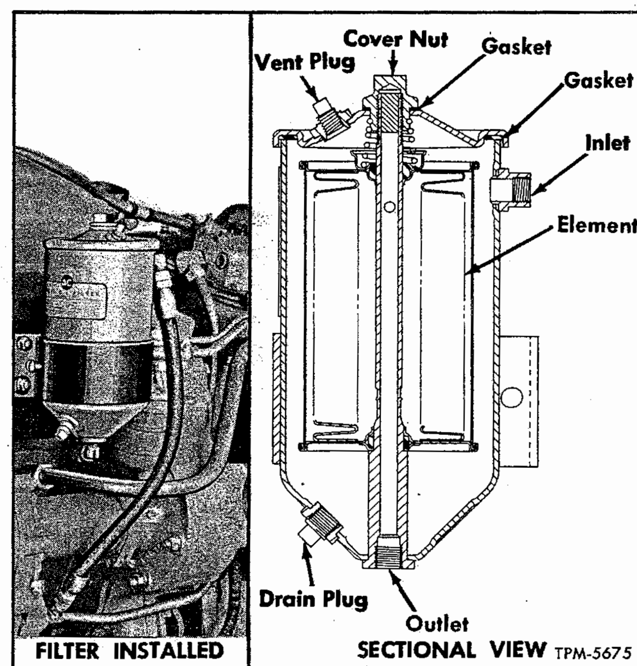


Figure 6—Fuel Oil Secondary Filter

be removed in engine compartment to permit use of air hose to clean right-hand screen from inner side. Screen in surge tank filler door can be cleaned readily with door opened.

ACCELERATOR CONTROLS

Lubrication and Inspection

Clevis pins and pivot points at accelerator control linkage must be lubricated periodically as instructed in LUBRICATION (SEC. 13). Cable and sliding ends are lubricated at time cable is installed and periodic lubrication is not required; however, the boots (16, fig. 2) should be inspected at regular inspection intervals. If boots or cable require replacement, lubricant as specified in LUBRICATION (SEC. 13) must be applied. Since correct adjustment of accelerator controls is necessary to prevent excessive strain on linkage, a periodic check should be made to assure proper adjustment as previously described under "Installation and Adjustment" in ACCELERATOR LINKAGE REPLACEMENT.

SPECIFICATIONS

FUEL FILTER

Primary (On Engine Bulkhead)

Make	AC
Type	Cleanable Strainer
Strainer Model	TL-12

Secondary (On Engine)

Make	AC
Type	Renewable
Element Model	TP-14

AIR CLEANERS

Number Used	3
Make	AC
Type	Oil Bath
Capacity	2 Qts. Ea.

FUEL TANK

Capacity	140 gal.

Lubrication

USE OF CHART

The separate lubrication chart at back of this manual indicates location of points requiring periodic lubrication. This chart will serve the purpose of approximately locating various fittings and points of lubrication. When necessary, more detailed information on accessibility of lubrication points is described in following paragraphs.

INTERVALS

Intervals indicated on the chart are recommended for normal service. More frequent intervals may be used, if necessary, under severe operating conditions.

LUBRICANTS

Types of recommended lubricants are indicated on the chart by symbols. Descriptions of these lubricants are given in following paragraphs covering each type of lubricant. In the selection of the proper type of oil lubricants, the reputation of the oil dealer must be considered, as the dealer must be responsible for the quality of his product. The descriptions of the lubricants given will assist the coach operator to demand the correct quality and type.

MEANING OF LUBRICANT SYMBOLS

Symbol	Type of Lubricant
E	Engine Oil
ES	Lubricating Oil
SG	Steering Gear Lubricant
MP	Multi-Purpose Lubricant
C	Chassis Lubricant
S2	15% Sodium Soap Grease
S3	Petroleum Jelly (Petrolatum)
S5	Graphite Grease
S13	Air Filter Fluid
S19	Automatic Transmission Fluid
S20	Special Lubricant

METHODS OF LUBRICATION

Various methods of applying lubricant are described in paragraphs following. Whenever cleaning, removal, or disassembly procedures are necessary to lubricate various units, such procedures are listed in applicable sections in the manual.

LUBRICATION AT ASSEMBLY

In addition to items shown on chart which are lubricated at regular intervals, some units are lubricated only at assembly. Refer to applicable section in manual for lubrication procedures on such items. The following tabulation shows type of lubricant to use.

Item	Symbol	Refer to
Radiator Shutter Linkage	E	Sec. 6
Steering Column Bearings and U-Joint	S2	Sec. 16
Clutch Shaft Splines	S5	Sec. 5
Accelerator Control Cable	S20	Sec. 12
Brake Application Valve	S3	Sec. 4
Heating System Blower Motor	--	Sec. 3

ENGINE OIL
(Symbol "E" On Chart)

Crankcase oils in service, unless protected by suitable addition agents, oxidize, form sludge and varnish, and, under some driving conditions, corrosive acids may accumulate in the crankcase. To minimize the formation of these harmful decomposition products and to supply the type of oil best suited for the different operating conditions, the oil industry now markets several types of oils which they designate by type; such as "ML," "MM," "MS," "DG," and "DS." Best quality heavy duty engine oils are designated for service "DG" or "DS."

RECOMMENDATIONS

For maximum protection of Diesel engine under all normal operation conditions, it is recommended that only Heavy Duty oils designed "FOR SERVICE DG," and meeting Specifications MIL-L-2104A, be used. Crankcase oils designated only for service, "ML," "MM," and "MS" are not recommended for use in GM diesel engine.

Since the quality and suitability of the lubricating oil is the responsibility of the supplier, it should be obtained from a reputable company and recommended by the supplier for use in GM Series 71 Diesel engine.

VISCOSITY

In cold weather operation, if vehicle is not stored in a heated garage, starting the engine may be difficult, if heavier oil than recommended is used. The use of lighter oils will not only lessen cold weather starting difficulties, but will result in fuel economy and longer engine life. For cor-

rect viscosity of oil used at various atmospheric temperatures refer to "Viscosity Chart" shown in figure 2. The S.A.E. viscosity numbers constitute a classification of lubricants in terms of viscosity or fluidity but with no reference to any other characteristics or properties.

CHECKING OIL LEVEL

A bayonet type oil gauge at the side of engine block is used to determine the quantity of oil in the engine oil pan. This gauge is marked with two designations, "Low" and "Full." Oil should never be allowed to drop below "Low" mark, and no advantage is gained by having oil above "Full" mark.

Crankcase oil level can be checked after lowering rear license door (fig. 3). Engine rear compartment door must be raised to add oil (fig. 1).

Daily, or oftener if necessary, check level with engine at normal operating temperature and after engine has stopped for 1-1/2 to 3 minutes. Remove dipstick, wipe with clean cloth, replace in crankcase and remove again. Note oil on dipstick and, if necessary, add sufficient oil to bring level up to "Full" mark. Never run engine if oil is below "Low" mark.

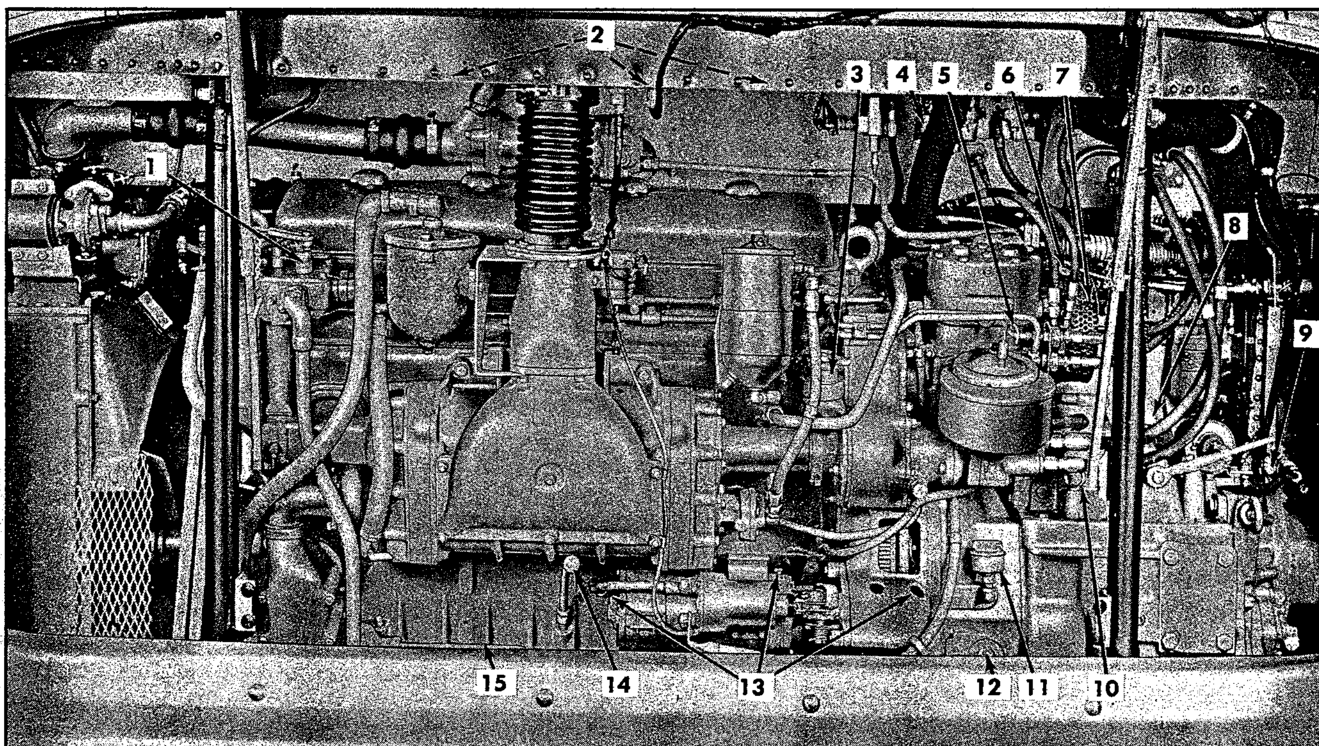
OIL CHANGE PERIODS

The frequency with which crankcase oil must be changed depends upon the type and quality of oil used as well as the type and severity of operation, and the condition of the engine. However, it is imperative that regular intervals (suggested 1500-2000 miles) be established and crankcase oil and oil filter element be changed regularly. The oil should be changed often enough to keep it non-abrasive and non-corrosive. Oil changing is closely related to filter element and air cleaner element cleaning and changing, the frequency of which also depends upon the condition of operation mentioned above.

Laboratory tests of oil drained from the engine, conducted by the oil supplier or by other suitable laboratories should be helpful in determining the interval between oil and filter element changes for your operation. Whether such tests are conducted or not, your oil supplier should be able to recommend suitable oil change periods for his oil in your operation.

CHANGING TYPE OF OIL

In some instances operators may desire to



1 Governor Throttle Shaft
2 Blower Air Cleaners
3 Engine Oil Filler
4 Shutter Air Filter
5 Power Steering Reservoir Dipstick
6 Generator
7 Generator Air Cleaner
8 Hand Brake Bell Crank Idler
9 Speedometer Adapter
10 Transmission Dipstick
11 Clutch Release Bearing
12 Clutch Release Cross Shaft
13 Starter
14 Engine Oil Dipstick
15 Engine Oil Filter

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Figure 1—Lubrication Points Located in Engine Compartment

change type of oil. If this is the case the following procedure is recommended when "Heavy Duty" type engine oil is first used. The engine should not be run for more than 24 hours on the new oil, then drained and refilled. This prevents any dangerous obstruction of oil pump intake screen or oil strainer by any previously formed oxidation deposits which might be loosened by purging action of oil.

The second crankcase filling should be drained out after running 40 hours, at which time oil filter element should be renewed. Following these two oil changes, the previously recommended or newly established oil drain periods can be followed.

OTHER ENGINE OIL USES

BLOWER AIR CLEANERS

Blower air cleaners, accessible after engine compartment door is raised (fig. 3), should be serviced at intervals recommended on chart. If service conditions warrant, cleaning and servicing intervals should be more frequent.

1. Release two latches near bottom, then pull reservoir downward.
2. Lift oil baffle from reservoir, then pour oil from reservoir. Clean reservoir and baffle in cleaning fluid to remove all accumulated deposits.
3. Pull element downward and out of cleaner body. Slush element up and down in bath of cleaning fluid, until all oil and dirt deposits are removed. Permit element to dry thoroughly, but do not use compressed air.
4. Whenever inspection indicates that space between body and liner is restricted, liner should be removed and cleaned.
5. Reinstall element in cleaner body liner, being sure that element is pushed up as far as possible.
6. Fill reservoir up to "OIL LEVEL" mark on bracket at center of reservoir, using same grade of oil as used in engine. Also fill reservoir area outside of baffle, as shown in figure 4. Install oil baffle at center of reservoir.
7. Install reservoir to cleaner body, then secure with two latches.

OIL FILTER AND STRAINER

Whenever engine crankcase oil is changed, the oil filter element should be changed and strainer cleaned. Regular changing of filter element and cleaning strainer will help to keep engine oil contamination at a minimum.

Refer to DIESEL ENGINE (SEC. 8) for necessary service procedures.

GENERATOR AIR CLEANER

Generator air cleaner, attached to end of generator (fig. 1), should be serviced at intervals

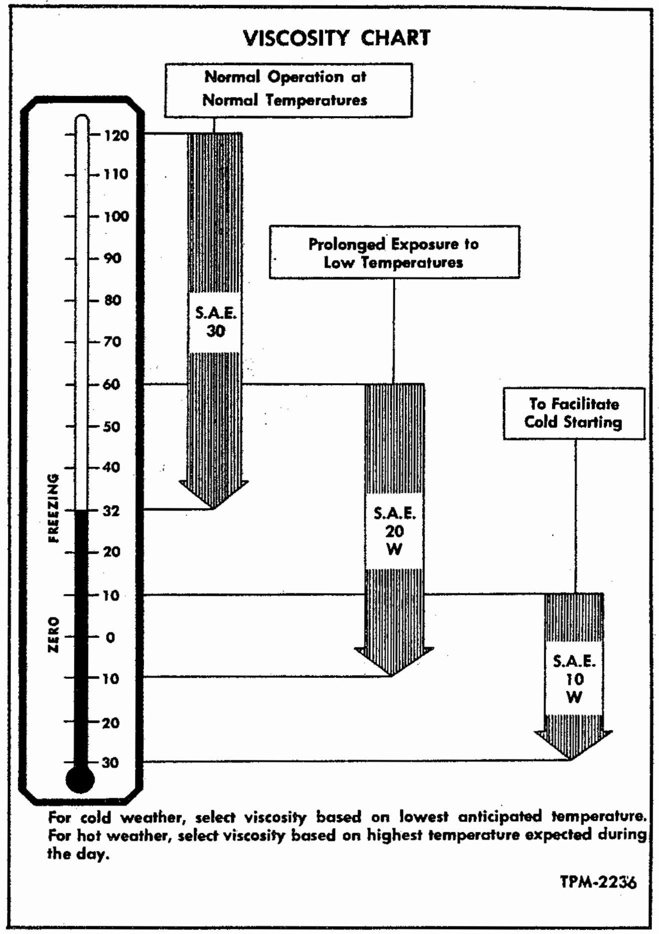


Figure 2—Engine Oil Viscosity Chart

shown on chart, or more often if conditions necessitate.

Remove four wing nuts which attach cleaner cover to bearing end plate. Remove cover and air cleaner. Wash element in cleaning solvent. Dry

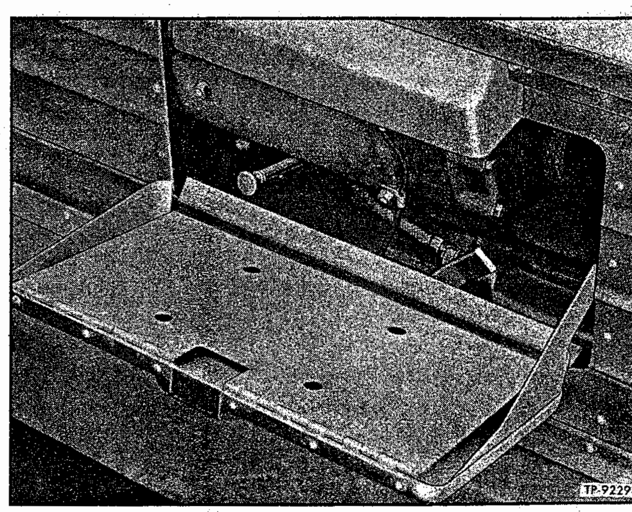


Figure 3—Access To Crankcase Dipstick

Figure 4—Oil Level In Air Cleaners

thoroughly. Wet mesh element in light engine oil (S.A.E. 10). Allow excess oil to drain before reinstalling.

STARTER

Starter is equipped with three oilers (fig. 3). Two of these are accessible on the body of starter. Outboard oiler is accessible through a hole in flywheel housing (fig. 1). Use S.A.E. 10.

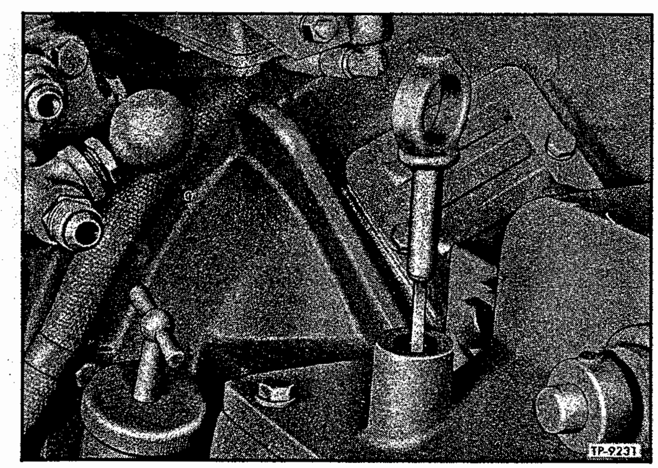


Figure 5—Transmission Dipstick

CONTROL ROD LINKAGE

All control rod linkage pins and joints should be oiled regularly with light engine oil. Use can or spray.

LUBRICATING OIL—SPECIAL

(Symbol "ES" On Chart)

Type of oil indicated by symbol "ES" on chart must be an S.A.E. 50 engine oil of good quality such as "Aviation Grade Engine Oil" or S.A.E. 50 Heavy Duty Engine Oil designated as for service "DG." Ordinary gear oils are not satisfactory.

TRANSMISSION

Checking Level

Transmission oil level dipstick (fig. 5) is marked "COLD" "LEVEL" "HOT." The dipstick is accessible after engine compartment door is raised (fig. 1).

Oil level should be checked immediately after a run when the oil in transmission is hot. The oil level should then be at "HOT" mark on dipstick. If level is checked after transmission has cooled, such as overnight, the oil level should be at "COLD" mark on dipstick.

Draining

Transmission should be drained while unit is warm, preferably immediately after a run. There are two drain plugs, one in the transmission case sump and one in angle drive housing. These are accessible under the engine compartment after compartment end bottom pan is dropped. Remove both plugs to completely drain the unit. Both plugs are magnetic type, and should be thoroughly cleaned before reinstalling.

Filling

After transmission is thoroughly drained, fill through top filler plug hole. The capacity of transmission is approximately 21 pints. Check level at dipstick a few minutes after transmission is filled. Level should be brought to "COLD" mark on dipstick.

STEERING GEAR LUBRICANT

(Symbol "SG" On Chart)

The lubricant indicated by the symbol "SG" is a special steering gear lubricant, No. 0 grade with low cold test characteristics and extreme pressure properties. This type of lubricant is marketed by many oil companies. In the event that cold test extreme pressure lubricant meeting the above specifications cannot be obtained, use #1 Multi-Purpose (lithium base) grease.

STEERING COLUMN BEVEL GEAR HOUSING

Steering column bevel gear housing is accessible in tool compartment after compartment door

is opened. Compartment is located at left front corner of coach.

Fill housing through fitting until lubricant flows from breather mounted on housing.

STEERING GEAR HOUSING

Remove plug at top of housing. Fill housing through lubrication fitting until lubricant is level with plug opening.

TACHOGRAPH DRIVE

At recommended intervals, remove left front hub cap, also cap screw at front of left steering knuckle and install lubrication fitting temporarily in knuckle. Apply lubricant with hand gun. Reinstall hub cap and cap screw.

CABLES

Remove inside cable from speedometer, tachometer and tachograph cable housing. Coat lightly with lubricant and avoid excessive amount.

MULTI-PURPOSE GEAR LUBRICANT

(Symbol "MP" On Chart)

Multi-Purpose gear lubricant, indicated by symbol "MP" on chart, must be carefully compounded, and of the latest non-corrosive type of proved quality. The lubricant must conform to "Military Specifications MIL-L-2105." The lubricant manufacturer must be responsible for the quality and satisfactory performance of his product. His reputation is the best indication of quality.

VISCOSITY

S.A.E. 140 should be used the year around, except in cases of extremely low temperatures. If vehicle is parked in temperatures below +20°F., or operated in temperatures consistently below 0°F., it is advisable to use S.A.E. 90.

REAR AXLE

Checking Level

At intervals indicated on chart, remove filler plug in differential cover. Add sufficient lubricant to bring level up to filler plug opening. Install and tighten plug. Check level after a run or while differential is warm.

Draining and Filling

When axle is new, or after overhaul, it is recommended that lubricant be drained after the first 3,000 miles of operation, and thereafter at recommended intervals. Draining at an early mileage removes fine particles of metal or other foreign material.

At recommended intervals, remove plug at bottom of housing to drain lubricant. Drain when unit is hot, preferably immediately after operation. Reinstall and tighten drain plug.

Fill axle to level of filler plug in housing cover. Install and tighten level plug. Capacity of rear axle is approximately 18 pints.

MULTI-PURPOSE GREASE

(Symbol "MPG" On Chart)

Grease, indicated by the symbol "MPG" on lubrication chart, is a grease having a lithium soap base, and is marketed by many oil companies.

UNDER FLOOR BLOWER BEARINGS

Grease used at these bearings, should be of N.L.G.I. #2 consistency. Apply only while blower is operating, using only one stroke of a hand grease gun.

CHASSIS LUBRICANT

(Symbol "C" On Chart)

Chassis lubricant should be a high grade calcium, lithium, or aluminum soap pressure gun lubricant. Sodium soap grease may be used as chassis lubricant, but more frequent application may be required during wet weather. This lubricant should be used at all points indicated by the symbol "C" on chart.

All pressure gun lubrication fittings must be clean before applying gun. Apply sufficient lubricant to thoroughly lubricate entire bearing or bushing.

LOCATION OF POINTS

The chart at back of book shows relative location of chassis lubricant points. Locations described in following paragraphs, however, will assist in readily locating these points.

UNDER VEHICLE (FRONT)

- Steering Knuckles
- Steering Tie Rod Ends
- Steering Drag Link Ends
- Steering Booster Ends (When Used)
- Steering Rear Prop. Shaft U-Joints
- Front Slack Adjusters
- Front Brake Camshafts
- Steering Prop. Shaft Support Bearing

UNDER VEHICLE (REAR)

- Rear Slack Adjusters
- Rear Brake Camshafts
- Prop. Shaft U-Joint
- Prop. Shaft Slip Joint
- Control Rods Bell Crank Pin

IN TOOL COMPARTMENT (LEFT FRONT CORNER)
Steering Front Prop. Shaft U-Joint
Steering Prop. Shaft Slip Joint
Brake Application Valve
Clutch Pedal
Clutch Control Cross Shaft
Transmission Control Tower

ENGINE COMPARTMENT
Hand Brake Bell Crank Idler
Hand Brake Shoe Anchor Pin (Under Comp't.)
Speedometer Adapter
Clutch Release Cross Shaft Ends

FRONT DOOR HINGES
Lower hinge fitting accessible at outside of coach. Upper hinge is accessible through safety compartment inside of coach.

15% SODIUM SOAP GREASE
(Symbol "S2" On Chart)

Lubricant indicated by symbol "S2" on chart, should be a short fiber sodium soap (approx. 15%) grease having a high melting point.

CLUTCH RELEASE BEARING
Clutch release bearing grease cup is accessible after engine compartment door is opened (fig. 1). Keep full. Turn down at intervals indicated on chart.

CLUTCH PILOT BEARING
Drop engine compartment bottom center shield. Through opening in flywheel housing, turn flywheel with a bar until plug in flywheel is in line with housing opening. Remove plug and install temporary fitting. Sparingly apply lubricant through fitting. Remove fitting and reinstall plug firmly.

WHEEL BEARINGS
Remove wheel bearings and clean hubs, bearings, and spindle as described in "HUBS AND BEARINGS" (SEC. 19).

Coat spindle and inside of hub with thin coat (approx. 1/8" thick) of grease to prevent rusting. Lubricate bearings thoroughly. Hand pack or use a lubricator. Be certain that grease reaches into all spaces of the bearings. DO NOT FILL HUB.

After bearings are reinstalled, adjust as described in "HUBS AND BEARINGS" (SEC. 19).

PETROLEUM JELLY
(Symbol "S3" On Chart)

BATTERY TERMINALS
Keep battery terminals clean. At regular intervals, remove cables; then clean terminals on cables and batteries. Apply petroleum jelly after tightening terminals to prevent corrosion.

BRAKE APPLICATION VALVE
At time of reassembly, apply petroleum jelly to application valve parts as described in BRAKES (SEC. 4).

GRAPHITE GREASE
(Symbol "S5" On Chart)

Lubricant indicated by symbol "S5" should be a high temperature grease containing graphite or other inert materials.

CLUTCH SHAFT SPLINES
At time of assembly, apply lubricant to clutch shaft splines and hub as directed in CLUTCH (SEC. 5). Do not use an excessive amount of lubricant.

RADIATOR SHUTTER FLUID
(Symbol "S13" On Chart)

Fluid, indicated by "S13" on chart, is a special shutter fluid available from Kysor Heater Co., Cadillac, Michigan.

SHUTTER AIR FILTER
Remove plug at top of filter reservoir. Inject 1 oz. of fluid. Do not use a large quantity or at more frequent intervals than indicated on chart. Reinstall and tighten plug.

SHUTTER THERMOSTAT
Shutter thermostat is lubricated and protected against deposit formations by special air filter fluid, injected into air stream at air filter.

SHUTTER AIR CYLINDER
Shutter air cylinder is lubricated by air filter fluid, injected into air stream at air filter.

SPECIAL HYDRAULIC FLUID
(Symbol "S19" On Chart)

Fluid indicated by symbol "S19" on chart, must be an "Automatic Transmission Fluid, Type A" supplied by a reputable dealer from containers bearing the Armour Institute qualification number prefix "AQ-ATF." DO NOT USE ANY OTHER FLUID.

POWER STEERING SYSTEM
The supply tank for power steering system is mounted with the system pump on engine timing gear housing. The level of fluid in the tank should be checked at intervals indicated on chart.

To replenish tank to "FULL" mark on dipstick remove bolt in cover. After thoroughly cleaning around cover, remove cover. The fluid should be poured through a 200-mesh screen which may be placed or soldered in the large end of a funnel. Before using funnel, make certain that it is clean. Do not use a cloth strainer when filling or adding fluid to system. Cloth strainers contain lint which is harmful to the system. Install cover securely.

BLEEDING POWER STEERING SYSTEM

Whenever a line is disconnected or a pump is replaced, the air that has entered the hydraulic system must be bled out, otherwise noisy and unsatisfactory operation will result.

1. Fill oil reservoir and let oil remain undisturbed for about two minutes.
2. Raise front end of vehicle so that wheels are off the ground.
3. Turn the wheels to right and left to the wheel stops to eliminate air pockets in power cylinder. Continue this operation until fluid in reservoir stops bubbling. Replenish fluid in reservoir during this operation.
4. Start the engine and run at idle for two minutes. Turn wheels right and left as before. DO NOT HIT WHEEL STOPS. Recheck fluid level, and hoses and connections for leaks. Continue this operation until oil is clear of bubbles.
5. Increase engine speed to approximately two-thirds of full throttle and continue to run at this speed until all signs of bubbles disappear from oil in reservoir as wheels are turned from right to left. DO NOT HIT STOPS.
6. Lower the vehicle and turn the wheels on the ground. Recheck system for leaks. Check fluid in reservoir and refill to "FULL" mark on dipstick as previously directed.

DO NOT USE HYDRAULIC BRAKE FLUID OR SHOCK ABSORBER FLUID. CARE SHOULD BE TAKEN TO KEEP THE FLUID CLEAN AND FREE OF WATER.

SPECIAL LUBRICANT

(Symbol "S20" On Chart)

Lubricant to be used on accelerator control cables is available through United Motors Service Stations as "AC-640," or at AC Spark Plug Distributors as "Type ST-640." Refer to FUEL SYSTEM (SEC. 12) for control cable lubricating procedures.

USE

THE RIGHT LUBRICANT

AT

THE RIGHT PLACE

AT

THE RIGHT TIME

Air Suspension

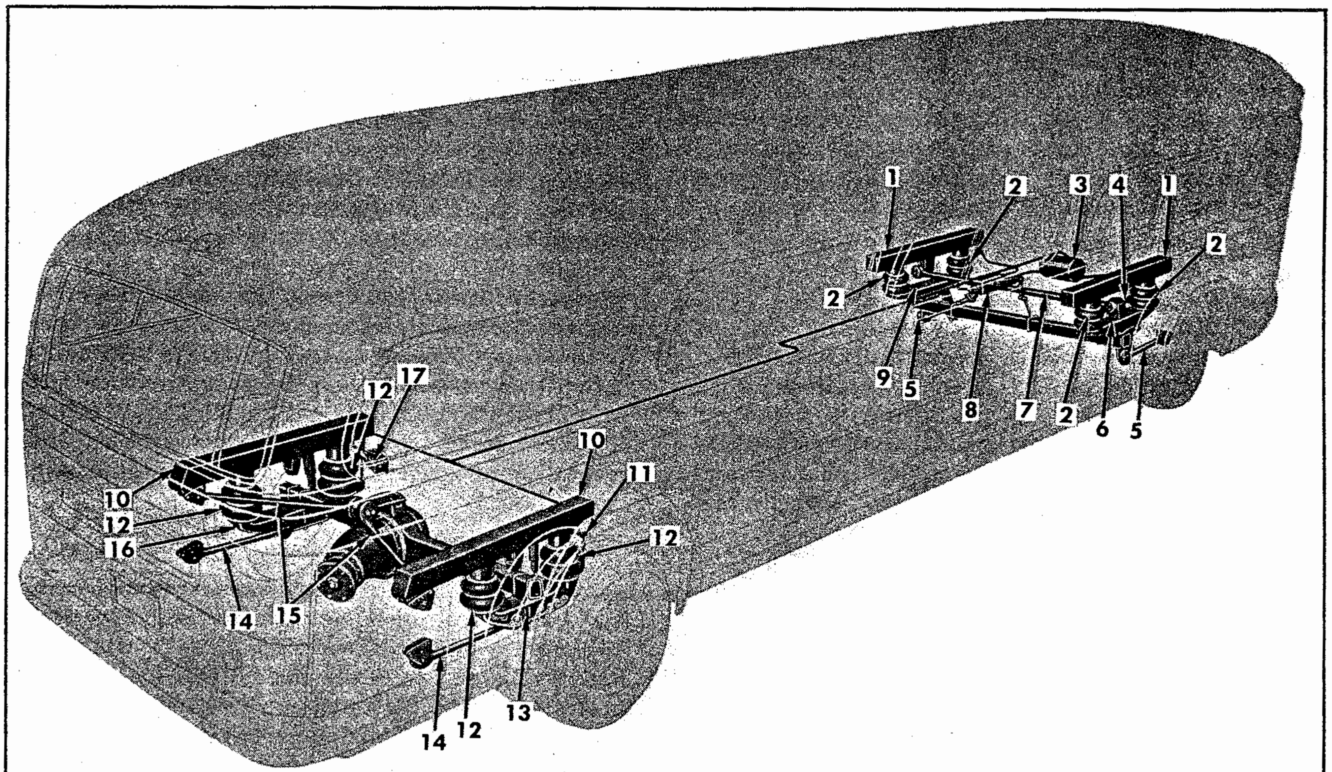
Information in this section covers complete description, operation, and maintenance of the air suspension system, as well as replacement of the various air suspension components. Since replacement of the front and rear axles consists primarily of disconnecting and connecting the air suspension components, these procedures are also included in this section. Phantom view of coach showing axles and air suspension system is illustrated in figure 1.

SYSTEM DESCRIPTION

Air suspension system is basically comprised of four air beams, eight air bellows, three height control valves, and radius rods and shock absorbers at each axle. Suspension supports provide a means of connecting the suspension system to the axles. Operation of system is completely automatic, maintaining a constant vehicle height regardless of load.

Air beams are formed by two welded steel box longitudinal members over each axle and are an integral part of the coach body framing. Two flanged tubes are welded to bottom of each air beam. Interior of each air beam is coated with a film of rust preventive compound.

Vertical loads are taken by eight rubberized nylon tire fabric air bellows assemblies. Four 12" bellows are used at rear axle, and four 9" bellows are used at front axle. Bellows are installed between air beams in coach body structure and suspension supports attached to axles. Bead rings and



1 Front Suspension Air Beams
2 Front Suspension Air Bellows
3 Auxiliary Air Tank
4 Front Axle Upper Radius Rod
5 Front Axle Lower Radius Rods
6 Front Suspension Support (Right)
7 Front Axle Lateral Stay Rod
8 Front Suspension Height Control Valve
9 Front Suspension Support (Left)
10 Rear Suspension Air Beams
11 Rear Suspension Height Control Valve (Right)
12 Rear Suspension Air Bellows
13 Rear Suspension Support (Right)
14 Rear Axle Lower Radius Rods
15 Rear Axle Upper Radius Rods
16 Rear Suspension Support (Left)
17 Rear Suspension Height Control Valve (Left)

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Figure 1—Phantom View of Coach Showing Axles and Air Suspension System

special bolts clamp the heavy ribbed bead at each end of bellows to air beam tube flanges and to bellows pads on suspension supports, forming an air-tight seal. Girdle ring around center of each bellows reinforces the bellows without affecting its flexibility.

Air pressure in air beams controls the spring rate. Air pressure in air beams is varied automatically in proportion to vehicle load by means of three height control valves, one at front and two at rear, maintaining constant vehicle height for all load conditions. Height control valve arms are connected to axles by adjustable links.

Radius rods, four at rear axle and three at front axle, transmit driving and braking forces from the axles to the coach body. Radius rods, and lateral stay rod at front axle, also control the lateral and longitudinal position of each axle under the vehicle. Radius rods and lateral stay rod are rubber mounted at each end and require no lubrication.

Aircraft type double-acting shock absorbers are used at both sides at front and rear axles.

Suspension supports used at rear axles are welded assemblies with bellows plates. Lower radius rod anchor pins and shock absorber lower anchor pins are also mounted in rear suspension supports. Upper front radius rod and lateral stay rod anchor pins are an integral part of the right side suspension support assembly.

SYSTEM OPERATION

Compressed air from the auxiliary air tank is supplied to the height control valves which in turn meter it to the air suspension system. Height control valves (one at front and two at rear) are actuated by relative movement between body and axles. For instances, as the coach is loaded, resulting in a tendency of the coach body to settle toward the axles, the height control valves automatically meter more compressed air into the system, increasing the air pressure to compensate for the added weight. This keeps the coach body at its original height.

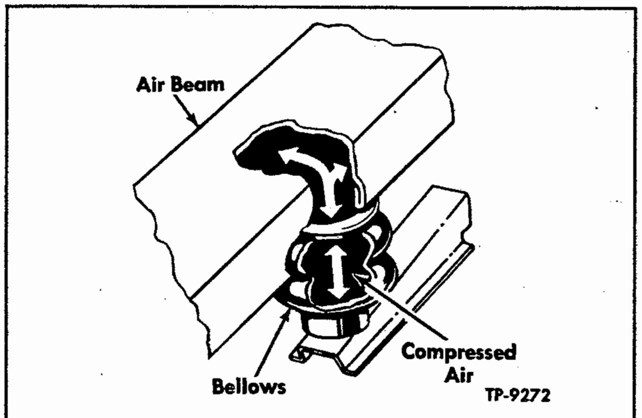


Figure 2—Cut-Away Sketch of Air Beam and Bellows

As the coach is unloaded, the height control valves release air from the system, decreasing the pressure and again keeping the coach body at the same height. Air pressure released from the air suspension system is exhausted to atmosphere through the discharge valves in the height control valves. Check valves at height control valve inlet ports prevent loss of air pressure from air suspension system in the event of pressure loss from the coach auxiliary air system. Refer to "Height Control Valves" later in this section for detailed description of height control valve operation.

The height control valves are designed to operate only when coach load is increased or decreased, and do not respond to rapid relative motion between axles and body such as that caused by road irregularities.

Each of the four air beams with the two bellows connected to it form a single compartment for compressed air (fig. 2). The bellows serve as a flexible connection between the body and the axles. The flexing of the air bellows results in alternate increase and decrease in the air volume within the compartment. This acts to absorb road shock in the same manner that an inflated rubber tire acts as a cushion to absorb shock from road roughness.

Aircraft type double-acting shock absorbers used at both sides of front and rear axles control rebound and further cushion the ride. Refer to "Shock Absorbers" later in this section for detailed description of shock absorber operation.

Radius rods maintain the position of each axle against lateral, longitudinal, and torsional movement.

SYSTEM MAINTENANCE

Air suspension system requires no lubrication, and except for the inspection and test procedures outlined below, requires very little maintenance. By accomplishing these inspection and test procedures at established chassis inspection periods, sub-standard performance may be revealed before the condition becomes bad enough to cause operator complaints or failure on a run. Diagrammatic view of the suspension air system is shown in figure 3.

CAUTION: Do not attempt to work under vehicle without blocking body or placing vehicle over a pit. With air bellows deflated, there is not sufficient clearance under vehicle for a man on a creeper. Also, DO NOT strike air beams with a heavy hammer, and DO NOT drill holes into air beams.

AIR TANKS

Auxiliary air tank, as well as the main air system air tanks, must be drained daily to keep air system as free of moisture as possible. In cases of extreme cold weather, an alcohol evaporator should be installed in main air system to introduce alcohol vapor into the air system to prevent moisture from freezing.

AIR LEAKAGE TEST

With main air system at normal operating pressure (100-105 psi), coat all air suspension system air line connections and bellows mountings with soap and water solution. Air pressure leakage will be indicated by the appearance of bubbles. No leakage is permissible. Leakage at air line connections can sometimes be stopped by tightening the connection. Where air line connectors having rubber sleeves are used, replace rubber sleeve. If tightening bellows bead ring bolts does not stop leakage at bellows mounting, remove, inspect, and if necessary, replace bellows.

MOUNTING AND BELLOWS INSPECTION

Make a wrench-check for loose suspension support stud and U-bolt nuts, radius rod anchor pin stud nuts and anchor plate bolt nuts, shock absorber mountings, and height control valve mountings. Suspension support, radius rod, and shock absorber mountings must be tightened to torque listed in "Specifications" at end of this section. Visually inspect all bellows for cracks, bruises, or other damage which might develop into a rupture. Especially check for and remove tiny stones or other foreign particles which may have become lodged between the bellows and the girdle ring and bead rings. Replace with new bellows if any damage is evident.

AIR FILTERS

Air filters used at all height control valve air line connections (3 at front valve, 2 at each rear valve, fig. 3) should be removed, disassembled, and cleaned at regular intervals. Refer to "Air Filters" later in this section for service procedure.

HEIGHT CONTROL VALVES

With air system charged to normal operating pressure (100-105 psi on air pressure gauge in instrument panel), height control valves should automatically meter air into or out of the suspension air beams to maintain normal ride height under all load conditions. Check clearance between axle bumpers and axle (rear) or suspension supports (front). Clearance should be 3" at front and 3-1/4" at rear. If necessary, adjust height control valve link to obtain this clearance; lengthen link to

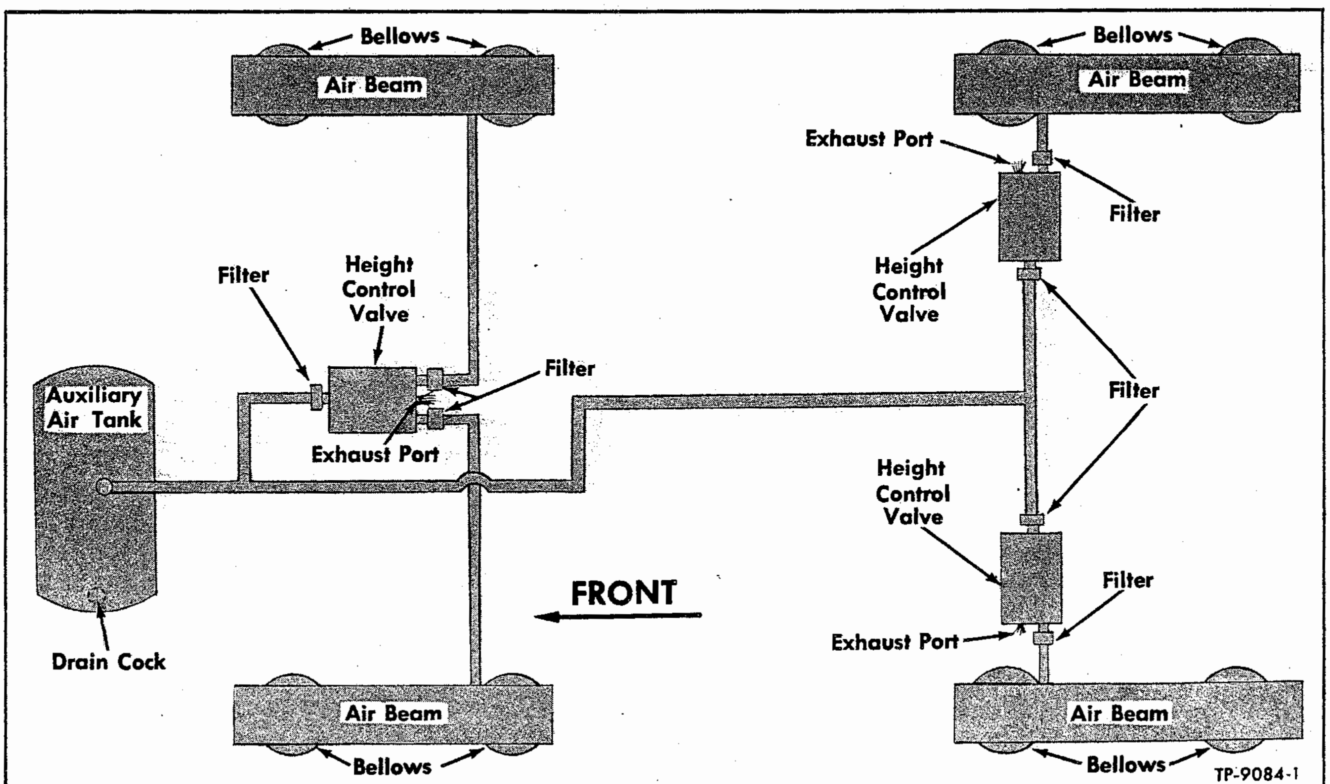


Figure 3—Diagram of Suspension Air System

increase clearance or shorten link to decrease clearance.

NOTE: Height control valve arm will move 3/16" to 1/4" up or down from its neutral position without causing any valve action. If amount of adjustment required falls within these limits, lengthen or shorten link the required amount; however, coach body will not raise or lower until load is increased or decreased to actuate the height control valve.

If either of the three height control valves do not maintain coach body at normal ride height with link correctly adjusted, check for clogged air filters and restricted air lines. If valve still does not maintain coach body at normal ride height, and it has been determined that the trouble is not due to improper link adjustment, clogged air filter, or restricted air lines, the complete control valve assembly must be removed and replaced with a new or factory reconditioned unit.

FRONT AXLE AND AIR SUSPENSION REMOVAL

The procedures which follow cover removal of the front axle assembly, including suspension components which are attached to the axle, and removal of the suspension components from the axle assembly. Method of supporting axle and suspension components during removal and disassembly is dependent upon local conditions and available equipment. Front axle and air suspension units installed are illustrated in figure 4.

REMOVAL PROCEDURE

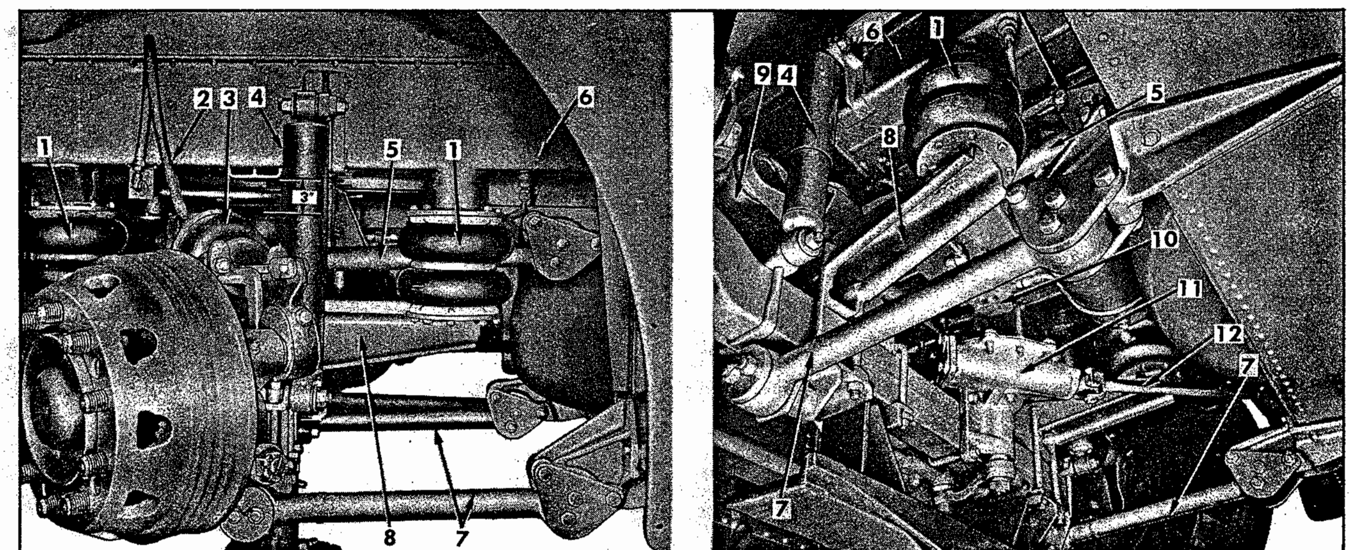
1. Block rear wheels to prevent vehicle rolling. Position a hydraulic floor jack under each lower radius rod axle bracket.

CAUTION: Blocks or special adapters should be used on jack lifts in a manner which will prevent axle rolling off jacks when disconnected.

2. Raise front end of vehicle with jacks until bottom of body is approximately 18" from floor. Block body in raised position, making sure each block is placed directly under a transverse bulkhead, and that no part attached to or adjacent to the bulkhead will be damaged when body is lowered onto blocks. NOTE: Do not raise body with hoist or chain fall and permit axle to hang unsupported, as air pressure will be exhausted from the air suspension system and the weight of the axle hanging on the deflated bellows may damage the bellows.

3. Lower jacks until body rests on blocks, but with jacks still supporting axle. Remove wheels and tires as directed in "WHEELS AND TIRES" (SEC. 19). Carefully swing ends of jacks out from under vehicle to provide free working area.

4. Exhaust air pressure from auxiliary air system by opening drain cock in air tank, located in compartment at left front corner of coach.



RIGHT SIDE VIEW

RIGHT FRONT SIDE VIEW

1 Air Bellows
2 Air Brake Hose
3 Brake Chamber
4 Shock Absorber
5 Upper Radius Rod
6 Air Beam
7 Lower Radius Rods
8 Suspension Support
9 Lateral Stay Rod
10 Height Control Valve
11 Steering Gear
12 Steering Gear Rear Drive Shaft

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Figure 4—Front Axle and Air Suspension Installed

5. Remove steering gear rear drive shaft as directed in STEERING SYSTEM (SEC. 16).

6. Disconnect hose from brake chambers.

7. Disconnect height control valve link from bracket which is welded to steering gear to axle U-bolt. Pull down on height control valve arm to exhaust air pressure from air suspension system.

8. If vehicle is equipped with power steering, disconnect hydraulic feed and return lines from hydraulic steering booster.

9. Disconnect both ends of all radius rods and lateral stay rod and remove rods from under vehicle as directed under "Radius Rods" later in this section.

10. Remove nuts and lock washers from bolts attaching air bellows lower bead rings to pads on suspension supports.

11. Remove shock absorbers as directed under "Shock Absorbers" later in this section.

12. Lower axle on jacks until bellows bead ring bolts are clear of suspension supports and axle will clear under side of vehicle. Carefully pull jacks and axle assembly from under vehicle.

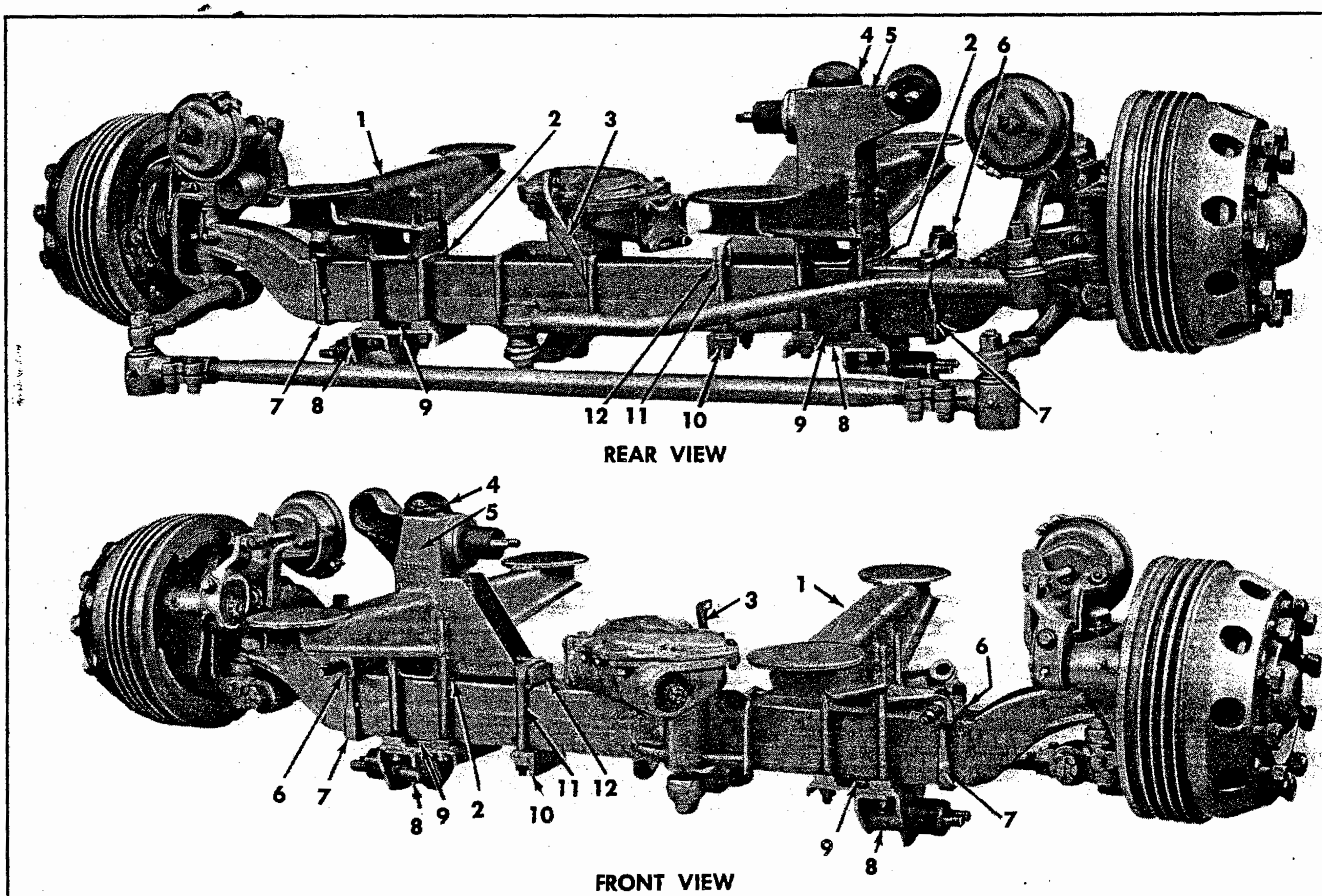
REMOVAL OF SUSPENSION COMPONENTS

NOTE: Key numbers in text refer to figure 5.

1. Support axle in a suitable manner which will permit removal of suspension supports. Make sure axle is supported securely and that suitable method of handling suspension supports is available to prevent personal injury.

2. Whenever hydraulic steering booster is used, disconnect booster from anchor bracket at left suspension support.

3. Remove four nuts securing each lower radius rod axle bracket (8) on suspension support studs. Remove bracket and spacer (9) at each end of axle.



1 Left Side Suspension Support
2 Support to Axle Spacer
3 Height Control Valve Link Bracket
4 Axle Bumper
5 Right Side Suspension Support
6 Shock Absorber Lower Anchor Bracket
7 U-Bolt
8 Radius Rod Axle Bracket
9 Radius Rod Bracket to Axle Spacer
10 U-Bolt Retainer
11 U-Bolt
12 U-Bolt Spacer

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Figure 5—Front Axle and Suspension Support Assembled

4. At right end of axle, remove two nuts and retainer (10) from U-bolt (11) attaching suspension brace to axle. Remove right side suspension support (5) from axle, then remove suspension support spacer (2) and U-bolt spacer (12) from top of axle. Also remove two nuts and U-bolt (7) attaching right shock absorber anchor bracket (6) to axle and remove bracket.

5. At left end of axle, remove nuts and U-bolt (7) attaching left shock absorber anchor bracket (6) and hydraulic steering booster anchor bracket (integral with suspension support) to axle. Remove left side suspension support (1), then remove suspension support spacer (2) from top of axle.

6. If necessary to remove brake components, hubs, steering gear, or hydraulic steering booster (when used), refer to applicable section in this manual for instructions.

7. Refer to FRONT AXLE (SEC. 1) for repair and adjustment of the front axle assembly.

FRONT AXLE AND AIR SUSPENSION INSTALLATION

ASSEMBLY OF AXLE AND SUSPENSION COMPONENTS

NOTE: Key numbers in text refer to figure 5.

This procedure covers preparation of the front axle for installation, based on the assumption that a new axle assembly, or a rebuilt axle from which the suspension components have been removed, is being installed. In any event, suspension units should be installed on axle as illustrated in figure 5 prior to installation under the vehicle. Method of supporting axle and suspension supports during assembly is dependent upon local conditions and available equipment. Use No. 110 Lubriplate on all stud and U-bolt nuts. Front axle and air suspension units installed are shown in figure 4.

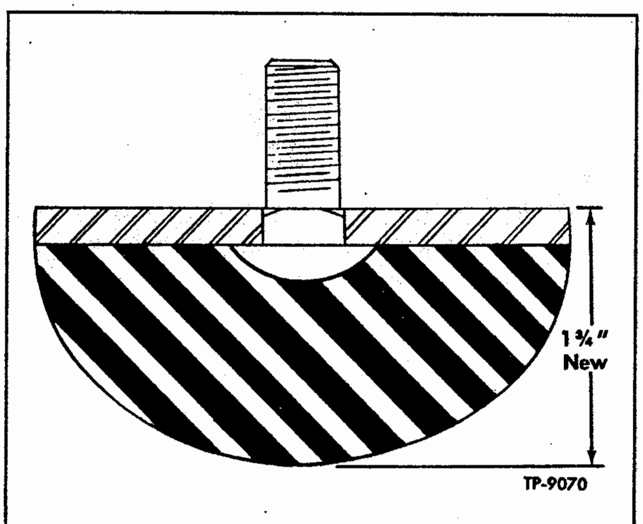


Figure 6—Original Thickness of Axle Bumper

1. Install each suspension support on axle, with spacer (2) between support and axle and with hole in support and spacer over dowel pin in axle. Place lower spacer (9) on lower radius rod axle bracket (8), install bracket under axle on support studs, and then install nuts on studs.

2. At left end of axle, place shock absorber axle bracket (6) under steering booster anchor bracket and attach with U-bolt (7) and nuts. Tighten U-bolt and stud nuts to torque listed in "Specifications."

3. At right end of axle, place U-bolt spacer (12) under suspension support brace, install U-bolt (11) over brace and axle, then install retainer (10) and nuts on U-bolt. Tighten U-bolt and stud nuts to torque listed in "Specifications."

4. Position right shock absorber axle bracket (6) on axle, with dowel pin in axle engaging hole in bracket, and secure with U-bolt (7) and nuts. Tighten nuts to torque listed in "Specifications."

5. If hydraulic steering booster (when used), steering gear, hubs, or brake components were removed from axle, install these parts on axle as directed in applicable sections in this manual.

INSTALLATION PROCEDURE

1. If bellows were removed from air beam tubes, they should be installed before axle is positioned under vehicle. Make sure mating surfaces on bellows bead rings and flange on air beam tubes are clean and smooth. Insert bellows clamp ring bolts up through flange on air beam tube and attach with nuts and lock washers. Tighten nuts alternately to draw bead ring evenly against flange on air beam tube.

2. Thoroughly clean all dirt, grease, or paint out of tapered holes in radius rods and lateral stay rod, and from radius rod and stay bar anchor pins. All surfaces contacted by rubber bushings must be thoroughly clean and dry.

3. Install rubber bushing in each end of all radius rods as directed under "Radius Rods" later in this section.

4. Make sure bellows mounting pads on suspension supports are clean. Position axle on two hydraulic floor jacks, with one jack lift under each lower radius rod axle bracket.

CAUTION: Blocks or special adapters should be used on jack lifts to prevent axle falling off jacks.

5. Carefully move jacks and axle into position under coach, positioning bellows pads on suspension supports under bellows. Raise axle at each end until bellows bead ring bolts can be inserted through bellows mounting pads.

6. Install lateral stay rod connecting right end to anchor pin on right suspension support and left end to anchor pin attached to left air beam. One anchor pin washer, and two stud nuts are required

at each end. Do not tighten nuts at this time.

7. Install lock washers and nuts on bolts attaching bellows lower bead rings to mounting pads. Tighten nuts alternately and evenly to draw bead rings down against mounting pads.

8. Install upper and lower radius rods. Refer to "Radius Rods" later in this section for installation instructions, but do not tighten stud nuts or bolts at this time.

9. Install shock absorbers (3) as directed later under "Shock Absorbers."

10. Position each end of axle by raising or lowering jacks to provide a clearance of 3" (normal ride height) between each axle bumper and contacting surface on suspension support (left side) and air beam (right side) (fig. 4).

NOTE: In the event the coach is left standing for extended periods without air pressure in the suspension system, the weight of the body on the rubber axle bumpers will cause the bumpers to take a permanent set in a flattened condition. Original thickness of new bumper assemblies is shown in figure 6. If bumpers are flattened to less than the new dimension shown, an equal amount should be added to the 3" clearance specified to maintain the correct normal ride height.

11. With axle in normal ride height position (step 10 above), connect radius rods as directed under "Radius Rods" later in this section.

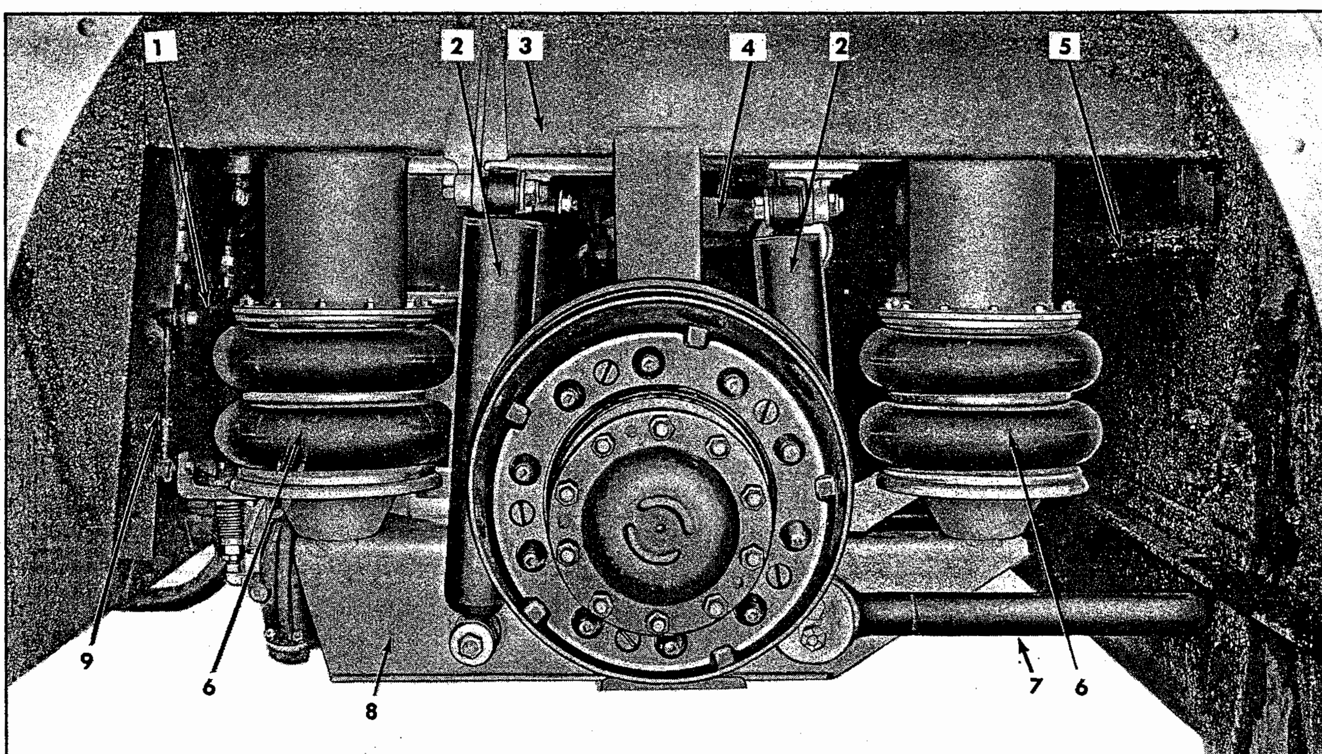
12. With axle still in normal ride height position (step 10 above), connect height control valve link to bracket on U-bolt at center of axle. Adjust link if necessary to permit free installation of link pin without moving height control arm out of neutral (horizontal) position.

13. Install steering gear rear drive shaft as directed in STEERING SYSTEM (SEC. 16). Also connect hydraulic feed and return lines to steering booster (if used).

14. Connect flexible hose at each brake chamber.

15. Swing jacks under vehicle to permit installation of wheels and tires. Refer to "WHEELS AND TIRES" (SEC. 19).

16. Raise coach and remove blocking from under body. Lower vehicle to floor and remove jacks. Build up air pressure in system to normal operating pressure, wait a few minutes for pressure to flow into suspension system, then check clearance between axle bumpers and suspension support (left side) and air beam (right side). If clearance is appreciably more or less than the



1 Height Control Valve	4 Radius Rod Anchor Bracket	7 Lower Radius Rod
2 Shock Absorber	5 Upper Radius Rod	8 Suspension Support
3 Air Beam	6 Air Bellows	9 Height Control Valve Link

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Figure 7—Rear Axle and Air Suspension Installed

dimension specified in step 10 above, adjust height control valve link as necessary to obtain this dimension. Adjustment is made by loosening lock nuts and turning turnbuckle with wrench. Lengthen link to increase clearance and shorten link to decrease clearance. Make sure lock nuts are firmly tightened against turnbuckle when adjustment is completed.

17. Check for air leakage at all upper and lower bellows mountings by coating with soap and water solution and watching for the appearance of bubbles. No leakage is permissible. If leakage is evident, bellows must be disconnected and mating surfaces cleaned, or bellows must be replaced if bead is damaged.

REAR AXLE AND AIR SUSPENSION REMOVAL

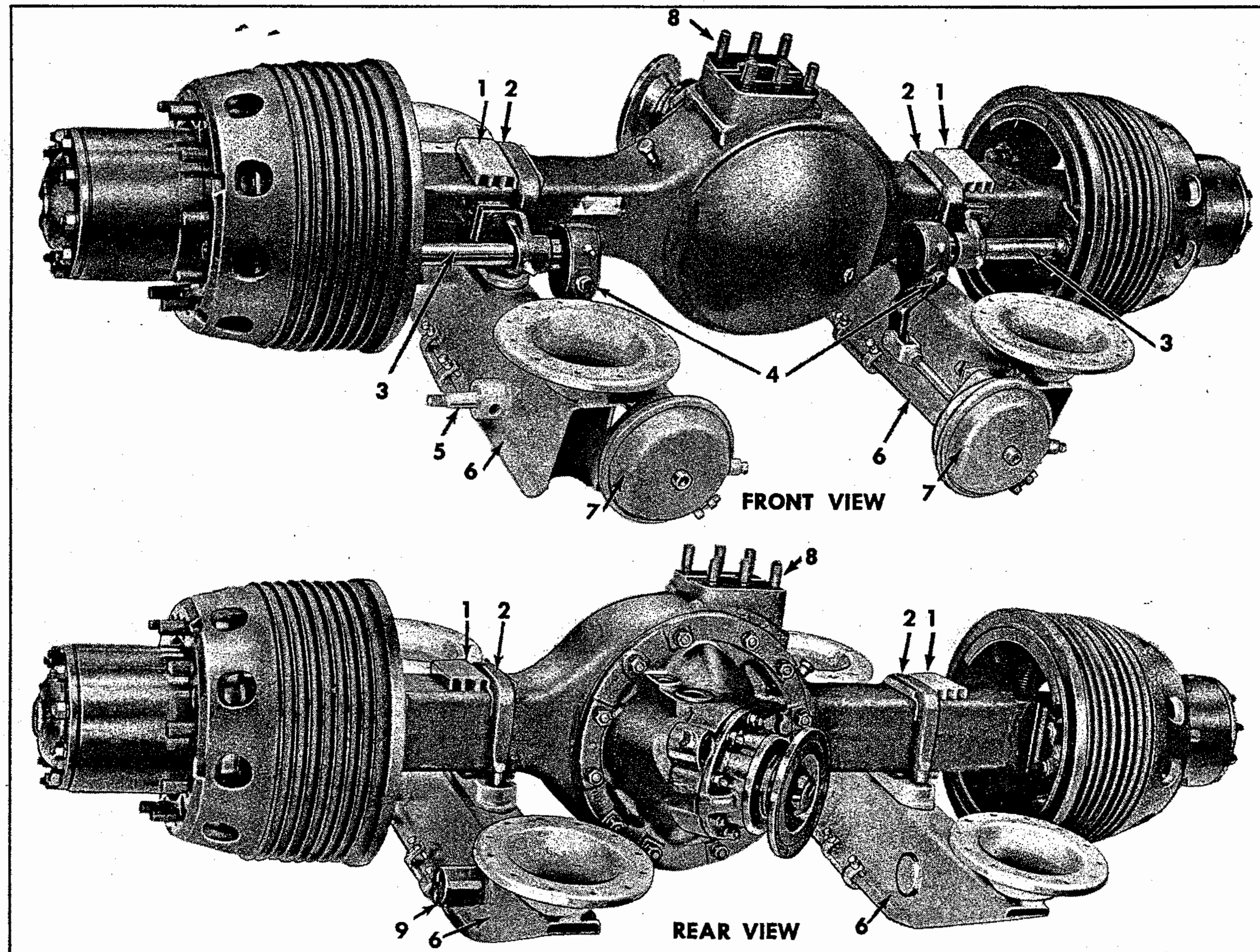
The procedures which follow cover removal of the rear axle assembly, including suspension components which are attached to the axle, and removal of the suspension components from the axle assembly. Method of supporting axle and suspension supports during removal and disassembly is dependent upon local conditions and available equipment. Rear axle and air suspension units installed are illustrated in figure 7.

REMOVAL PROCEDURE

1. Block front wheels to prevent vehicle rolling. Position a hydraulic floor jack under center of each rear suspension support.

CAUTION: Jack lifts should be equipped with large bowls, or other precautions should be taken to prevent axle from rolling off jacks when disconnected.

2. Raise rear end of vehicle with jacks until bottom of body is approximately 18" from floor. Block body in raised position, making sure each



1 U-Bolt Spacer
2 U-Bolt
3 Brake Camshaft
4 Slack Adjuster
5 Shock Absorber Anchor Pin
6 Suspension Support
7 Brake Camshaft
8 Radius Rod Bracket Studs
9 Radius Rod Anchor Pin

Figure 8—Rear Axle and Suspension Supports Assembled

block is placed directly under a transverse bulkhead, and that no parts attached to or adjacent to bulkhead will be damaged when body is lowered onto blocks. NOTE: Do not raise body with hoist or chain fall and permit axle to hang unsupported, as air pressure will be exhausted from the suspension system and the weight of the axle hanging on the deflated bellows may damage the bellows.

3. Lower jacks until body rests on blocks, but with jacks still supporting axle. Remove wheels and tires as directed in "WHEELS AND TIRES" (SEC. 19). Carefully swing ends of jacks out from under vehicle to provide free working area.

4. Exhaust air pressure from auxiliary air system by opening drain cock in auxiliary air tank, located in compartment at left front corner of coach.

5. Remove propeller shaft as directed in PROPELLER SHAFT (SEC. 18).

6. Disconnect flexible hose from brake chambers by holding connector body (threaded into elbow) while turning nut (next to spring guard). Spring will turn on hose while unscrewing connector nut from body. Pull hose off tube on connector body.

7. Disconnect height control valve links from brackets at forward bellows. Pull down on each height control valve arm to exhaust air pressure from air suspension system.

8. Disconnect both ends of lower radius rods and remove radius rods from under vehicle as directed later under "Radius Rods."

9. Remove nuts, lock washers, and flat washers from bolts attaching air bellows also height control valve link brackets, to suspension supports.

10. Remove six nuts, lock washers, and two tapered dowels, attaching upper radius rod anchor bracket to top of axle housing. Tap bracket to loosen on studs.

11. Remove shock absorbers as directed under "Shock Absorbers" later in this section.

12. Lower axle on jacks, tapping upper radius rod axle bracket off studs on top of axle, until bellows lower bead ring bolts are clear of suspension supports and axle will clear under side of vehicle. Carefully pull jacks and axle assembly from under vehicle.

REMOVAL OF SUSPENSION SUPPORTS

1. Support axle and suspension support assembly in a suitable manner which will permit removal of suspension supports from axle. Make sure axle is supported securely and that suitable method of handling suspension supports is available to prevent personal injury.

2. Remove brake chambers as directed in "AIR BRAKES" (SEC. 4).

3. Remove nuts from U-bolts (1) attaching suspension supports to axle, remove U-bolts and bumper pad, then remove suspension supports.

REAR AXLE AND AIR SUSPENSION INSTALLATION

ASSEMBLY OF AXLE AND SUSPENSION SUPPORTS (Fig. 8)

This procedure covers preparation of rear axle for installation, based on the assumption that a new axle assembly, or a rebuilt axle from which the suspension components have been removed, is being installed. In any event, suspension units should be installed on axle as illustrated in figure 8 prior to installation under the vehicle. If brake drum, brake shoes, brake camshaft, or hubs have been removed, install on axle as directed in applicable sections in this manual. Method of supporting axle and suspension supports during assembly is dependent upon local conditions and available equipment.

1. Make sure mating surface of air suspension supports and axle housing are clean and that locating dowels are in place in top of suspension supports.

2. Position suspension supports under axle, and with dowels in suspension supports engaging locating holes in bottom of axle housing. Attach each support to axle housing with U-bolts, U-bolt spacer, flat washers and nuts, using No. 110 Lubriplate on threads. Tighten nuts to torque listed in "Specifications."

INSTALLATION PROCEDURE

1. If bellows were removed from air beam tubes, they should be installed before axle is positioned under vehicle. Make sure mating surfaces on bellows bead rings and flange on air beam tubes are clean and smooth. Bellows must be installed with short bolts at top. Insert bellows clamp ring bolts up through flange on air beam tube and attach with nuts and lock washers. Tighten nuts alternately to draw bead ring evenly against flange on air beam tube.

2. Make sure bellows mounting pads on suspension support assemblies are clean. Position axle on two hydraulic floor jacks, with one jack lift under center of each suspension support.

CAUTION: Large bowls should be used on jack lifts or other precautions taken to prevent axle from rolling off jacks.

3. Carefully move jacks and axle into position under coach, positioning bellows pads on suspension supports under bellows. Raise axle at each end until bellows bead ring bolts can be inserted through bellows seal plates and mounting pads, at the same time guiding studs at top of axle housing up through upper radius rod anchor bracket.

4. Attach upper radius rod anchor bracket to axle with six stud nuts, lock washers, and two split tapered dowels. Tighten stud nuts firmly.

AIR SUSPENSION

5. Install flat washer, lock washer, and nut on all bellows lower bead ring bolts except the three bolts located at front side of each forward bellows. Install height control valve link bracket (32) on three bolts at front of each forward bellows and secure with lock washers and nuts. Tighten all bellows bead ring bolts alternately to draw lower bead ring and seal plate down evenly against bellows mounting pad.

6. Thoroughly clean all dirt, grease, or paint out of tapered holes in lower radius rods and from radius rod pins at axle. All surfaces contacted by radius rod rubber bushings must be clean and dry.

7. Connect lower radius rods to anchor pins in suspension supports at axle, using rubber bushing, one anchor pin washer, and two cap screws at each rod (fig. 9). Start cap screws but do not tighten.

8. Connect lower radius rods to brackets below bulkhead at front of wheelhousings. Refer to "Radius Rods" later in this section for installation instructions, but do not tighten bolts at this time.

9. Position axle to provide a clearance of 3-1/4" (normal ride height) between each rubber axle bumper and bumper pad on axle by raising or lowering jacks as necessary.

NOTE: In the event the coach is left standing for extended periods without air pressure in the suspension system, the weight of the body on the

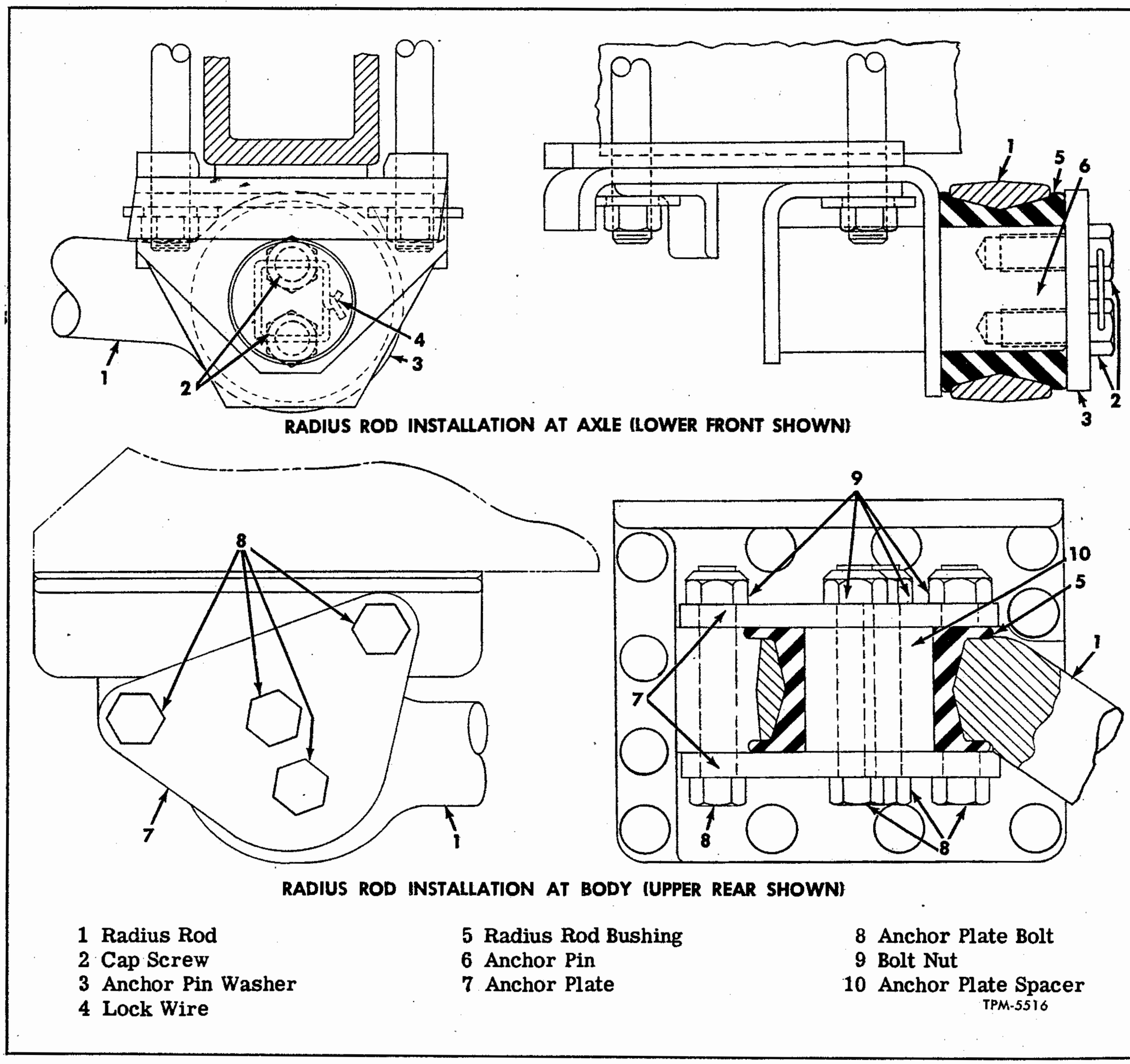


Figure 9—Radius Rod End Mountings

rubber axle bumpers will cause the bumpers to take a permanent set in a flattened condition. Original thickness of new bumper assemblies is shown in figure 6. If bumpers are flattened to less than the new dimension shown, an equal amount should be added to the 3-1/4" clearance specified to maintain the correct normal ride height.

10. With height control valve arms in neutral position (horizontal), adjust connecting links, if necessary, to permit free installation of link pins in brackets at forward bellows. Install nuts on link pins and tighten firmly.

11. With axle still in normal ride height position (step 9 above), tighten lower radius rod attaching cap screws and nuts to torque listed in "Specifications" at end of this section. Thread lock wire through cap screws at axle connections and twist ends of wire together.

12. Install propeller shaft as directed in PROPELLER SHAFT (SEC. 18).

13. Connect flexible hose to brake chambers as directed in "AIR BRAKES" (SEC. 4).

14. Swing jacks under vehicle to permit installing wheels and tires as directed in "WHEELS AND TIRES" (SEC. 19).

15. Raise coach body and remove blocking. Lower vehicle to floor and remove jacks. Build up air pressure in system to normal operating pressure, wait a few minutes for pressure to flow into suspension system, then check clearance between axle bumpers and U-bolt spacers. If appreciably more or less than dimension specified in step 9 above, adjust height control valve links as necessary to obtain this dimension. Adjustment is made by loosening lock nuts and turning the turnbuckle with wrench. Lengthen link to increase clearance and shorten link to decrease clearance. In any event, clearance at both ends of axle must be equal or coach will not be level. Make sure lock nuts are firmly tightened against turnbuckle when adjustment is completed.

16. Check for air leakage at all upper and lower bellows mountings by coating with soap and water solution and watching for the appearance of bubbles. No leakage is permissible. If leakage is evident, bellows must be disconnected and mating surfaces cleaned, or bellows must be replaced if bead is damaged.

RADIUS RODS AND FRONT AXLE LATERAL STAY ROD

All radius rods, and lateral stay rod used at front axle, are hollow steel tubes with steel forgings welded to each end. Rear axle upper radius rods are interchangeable with each other, rear axle lower radius rods are interchangeable with each other, and the three front axle radius rods are interchangeable with each other; however, radius rods are not interchangeable between front and rear axles. All front and rear radius rod bushings, anchor plates, and anchor plate spacers are interchangeable.

Radius rod connections at axle and at body are illustrated in figure 9. While anchor pin installations and body brackets at various points differ from the ones shown, attaching parts are identical at all points. Lateral stay rod at front end is connected at axle and at body bracket in same manner as shown in figure 9 for radius rod connection at axles.

RADIUS ROD REPLACEMENT (Fig. 9)

The following procedures include instructions for disconnecting and connecting radius rods at body and at axles. Radius rods must be disconnected at body before axle end can be removed from anchor pin. Instructions applying to radius rod connections at axle also apply to the front axle lateral stay rod. Raise body just enough to remove weight from air bellows and block in position before disconnecting radius rods or front axle lateral stay rod.

IMPORTANT: When any radius rod or the lateral stay rod has been disconnected, correct clearance between axle bumpers and axles must be obtained before tightening anchor pin cap screws or anchor plate bolts. If connections are tightened without first obtaining this clearance, a torsional preload will be imposed on the rubber bushings when the body assumes its normal ride height relative to the axles. Instructions under "Tighten Cap Screws and Bolt Nuts" must be followed explicitly.

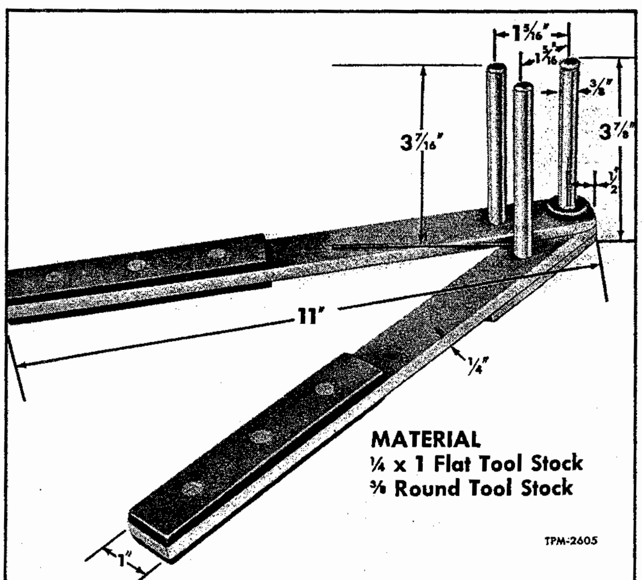


Figure 10—Radius Rod Bushing Installer

RADIUS ROD BUSHING REPLACEMENT

A special tool (fig. 10), which can be made locally, is effective when removing or installing one-piece rubber bushing in radius rod. Use of tool is illustrated in figure 11. Position tool over bushing as shown, then swing tool arms in direction of arrows to fold the bushing. With bushing folded on tool it can be easily removed or installed. Swing arms in opposite direction to unfold bushing and withdraw tool.

1. Remove Radius Rod at Body.

a. NOTE: Access to rear ends of rear axle upper radius rods is from under vehicle through opening between bulkhead at rear of wheelhousings and engine bulkhead.

b. Remove nuts from four anchor plate bolts, then remove bolts and anchor plates.

2. Remove Radius Rod at Axle. Cut lock wire and remove wire from cap screws. Remove anchor pin washer. Pull radius rod and bushings off anchor pins.

3. Inspection. Inspect radius rods for bent condition and for cracks. Any damage necessitates replacing with new part. Always use new rubber bushings at assembly. Thoroughly clean rod ends, anchor plate spacers, anchor pins, and anchor plates; any surface contacting rubber bushings must be clean, smooth, and dry. USE NO LUBRICANT (NOT EVEN WATER) ON BUSHINGS.

4. Install Radius Rod at Axle. Install anchor pin washer. Install two cap screws but do not tighten.

5. Install Radius Rod at Body.

a. Install anchor plate spacer in radius rod end.

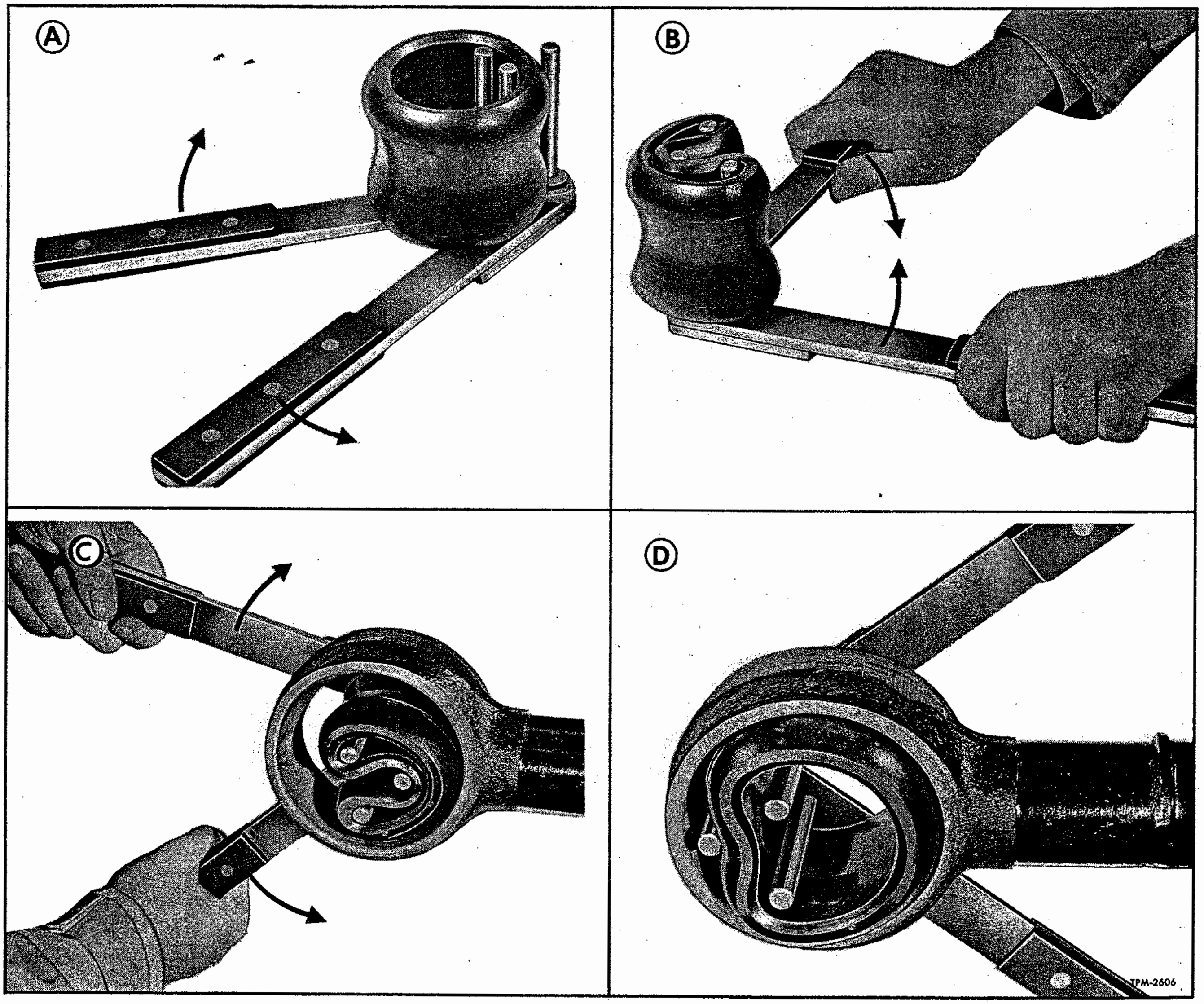


Figure 11—Use of Radius Rod Bushing Installer

b. Temporarily insert a 3/4 x 5-inch bolt through center hole in one anchor plate, insert bolt through upper hole in anchor plate spacer, then place other anchor plate over bolt. Install nut on bolt and tighten finger-tight.

c. Align other holes in anchor plates with holes in bracket and spacer and insert three permanent 3/4 x 4-1/4-inch bolts. Coat threads with No. 110 Lubriplate. Tighten nut on temporary bolt to draw anchor plates together, compressing rubber bushings, until nuts can be started on the other three bolts. Start nuts on bolts, remove temporary bolt, and install permanent bolt and nut.

6. Tighten Cap Screws and Bolt Nuts.

a. Refer to step 10 in "Installation Procedure" under "Front Axle and Air Suspension Installation" or "Rear Axle and Air Suspension Installation" for instructions on obtaining normal ride height clearance between axle bumpers and axles.

b. At body, alternately tighten each nut a little at a time to keep spacer centered in bushing. When tightened correctly space between radius rod and anchor plates will be equal on both sides.

c. At axle, use a pry bar to force radius rod end out toward anchor pin washer (fig. 12) while tightening anchor pin cap screws. Do not pinch edge of bushing with pry bar. Secure cap screw with lock wire threaded through head of cap screws.

d. Due to inaccessibility of rear axle upper radius rod rear nuts, torque wrench cannot be applied to nuts; tighten nuts until anchor plates are drawn up squarely and tightly against anchor plate bracket and spacer.

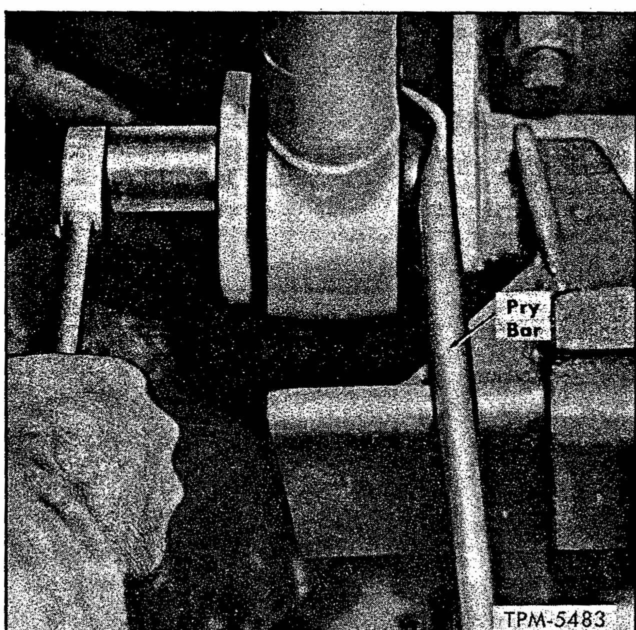


Figure 12—Tightening Radius Rod Cap Screws

AIR BELLOWS

Four rubberized nylon tire fabric bellows used at each axle provide the flexibility between the axles and the coach body, and at the same time retain the compressed air which supports the body. Bellows used at front are referred to as 9" bellows and bellows at rear as 12". These dimensions are the approximate outside diameters. Refer to "Specifications" at end of this section for effective diameters and travel dimensions.

Heavy bead at each end of bellows is reinforced with wire. Clamping surface of each bead is molded with concentric ribs which form an air-tight seal when bead ring bolts are tightened. Bead rings are drilled and machined for special bolts, and all surfaces contacting bellows are smooth so that no chafing of the bellows will occur. Girdle ring around center of each bellows is formed of steel tubing, welded and machined at the joint.

BELLOWS REMOVAL

1. Securely support coach body, placing blocks under transverse bulkhead at wheelhousing, or by placing blocks between axle bumpers and axle (rear) or suspension supports (front). If air pressure has been exhausted due to leakage, coach body should be raised and blocked up to facilitate replacing bellows.

2. If system is pressurized, disconnect height control valve link (1 at front, 2 at rear) and pull height control valve arm down to exhaust air pressure from air beams and bellows. Do not disturb height control valve link adjustment.

3. Remove nuts and lock washers (and flat washers at lower rear) from upper and lower bead ring bolts. Separate bead rings from air beam tube flange and pad on suspension supports and remove bellows assembly.

BELLOWS INSPECTION

Examine bellows inside and out for evidence of cracks, punctures, deterioration, or chafing. Replace with new bellows if any damage is evident, Bead rings and girdle ring can be removed from defective bellows and installed on new bellows. Clamping surface of bead rings must be clean and smooth. When installing bead rings on bellows, holes in upper and lower ring must be aligned so that no twist will be imposed on the bellows during installation.

BELLOWS INSTALLATION

1. If bolts were removed from bead rings, install bolts before positioning the bellows under the vehicle.

2. Make sure clamping surfaces on air beam tube flanges and pads on suspension supports are clean and smooth.

3. Bellows used at rear axle must be installed with short bolts at top. Install bellows assembly, with bolts engaging holes in air beam tube flanges and pads on suspension supports. Install lock washers and nuts (with flat washers at lower rear) and tighten alternately to draw bead rings evenly against clamping surfaces. At front bellows on rear axle, height control valve link brackets must be installed on the three bolts toward front of vehicle and secured with lock washer and nut.

4. If height control valve links were disconnected, connect link, making sure link adjustment (length) is not changed.

5. Build up air pressure in main air system to normal operating pressure. Remove blocks from under coach or from between axle bumpers and axle.

6. Check for air leakage at upper and lower bellows mountings by coating with soap and water solution. Any leakage evidenced by the appearance of bubbles must be corrected.

AIR FILTERS

Air filters (fig. 13) are used at all height control valve outlet ports (two at front valve and one at each rear valve, (fig. 18). Purpose of filters is to prevent any foreign matter which may be present in the air beams from entering the control valves when air pressure is exhausted from the air suspension system. Air filter assembly (fig. 13) is used at inlet port of each height control valve (fig. 18). Filters prevent foreign matter in auxiliary air system from entering the control valves.

Air filter assemblies should be removed and serviced at regular intervals. Clogged air strainers will retard the flow of compressed air into and out of the air suspension system. Air filter element is a cone-shaped porous bronze part held in place by a spring (fig. 13).

REMOVAL

1. Place blocking under coach body at transverse bulkheads, or place blocks between axle bumpers and axles to hold body in raised position when air pressure is exhausted from suspension system. Exhaust air pressure from auxiliary air system by opening drain cock in auxiliary air tank, located in compartment at left front corner of vehicle.

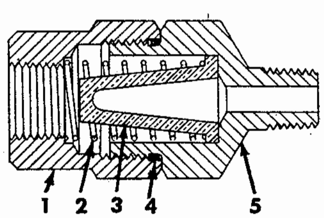


Figure 13—Air Filter

2. Disconnect height control valve link at one end and pull control valve arm down to exhaust air pressure from bellows and air beam. Do not disturb link adjustment.

3. Disconnect air lines from elbow or fitting at air filter cover. Unscrew air filter assembly from control valve body or from elbow in control valve, using end wrench on filter body (fig. 13). Remove fitting or elbow from filter cover.

DISASSEMBLY (Fig. 13)

Clamp filter body in vise, then use end wrench on filter cover to unscrew cover from body. Lift out filter element. Remove grommet from filter body.

CLEANING AND INSPECTION

1. Immerse all parts in suitable cleaning solvent and wash thoroughly. Blow out all parts with compressed air. Blow air through bronze filter from inside the cone.

2. Discard old grommet and use new grommet at assembly.

ASSEMBLY (Fig. 13)

Clamp filter body in vise, large end up. Coat new grommet with Lubriplate, then install grommet in groove at bottom of threads on filter body. Place filter element in body, small end up, and spring over element. Thread filter cover onto body and tighten firmly.

INSTALLATION

1. Assemble fittings and elbows to filter assemblies. Use Permatex Aviation "Form-A-Gasket" number 3 on male threads. Do not apply Permatex to first two threads. Tighten all fittings and elbows firmly.

2. Assemble filter assemblies to height control valve body, referring to figure 18 for location and position of parts. Tighten connections firmly.

3. Connect height control valve link, using care not to change link adjustment. Build up air pressure in system and check connections for leakage as previously directed under "System Maintenance." After tests, remove blocks from between axle and body.

HEIGHT CONTROL VALVES

DESCRIPTION

Height control valves are mechanically operated valves which automatically control the flow of compressed air into and out of the air suspension system. Upper portion of valve body contains the control valves, check valves, and internal passages which direct and control the flow of the completely sealed from the upper body, contains the mechanical actuating linkage, and the interconnected hydraulic pistons which provide a delaying action in the operation of the valve. Lower portion of valve is completely filled with shock absorber fluid.

HEIGHT CONTROL VALVE OPERATION

Figure 14 is labeled for identification of internal parts of height control valves. Schematic diagrams (figs. 15, 16, and 17) illustrate the function of a height control valve in the three phases of its operation. The diagrams actually illustrate the operation of a rear height control valve, which controls air pressure in air beam and bellows at one side only. Front height control valve, which controls air pressure in air beams and bellows at both sides of vehicle, functions in the same manner. Additional internal passages and check valves are provided in the air control portion of the front valve to direct the air pressure into and out of two air beams instead of one as illustrated. Each phase of height control valve operation is described below.

<u>Raising Coach Body (Fig. 15)</u>

When air pressure has been exhausted from the suspension system, or when passenger load increases, coach body settles toward axles. Since height control valve is mounted to body and control valve arm is connected to the axle, arm is moved upward from its neutral (horizontal) position as shown in figure 15. The arm shaft follower attempts to maintain a position parallel to the arm. Movement of follower forces the inlet valve off its seat, while air pressure and spring hold the exhaust valve closed. Compressed air from the auxiliary air tank flows through the open inlet valve, raises the check valve off its seat, and passes through the outlet port and air lines into the air beam and bellows. Air pressure expands the bellows and raises the coach body.

<u>Neutral Position (Body at Normal Ride Height (Fig. 16)</u>

As air pressure entering the bellows causes the coach body to rise, the height control valve also rises. When valve has risen enough to bring the control valve arm to its neutral (horizontal) position, the follower, which follows the arm to a horizontal position, permits air pressure and

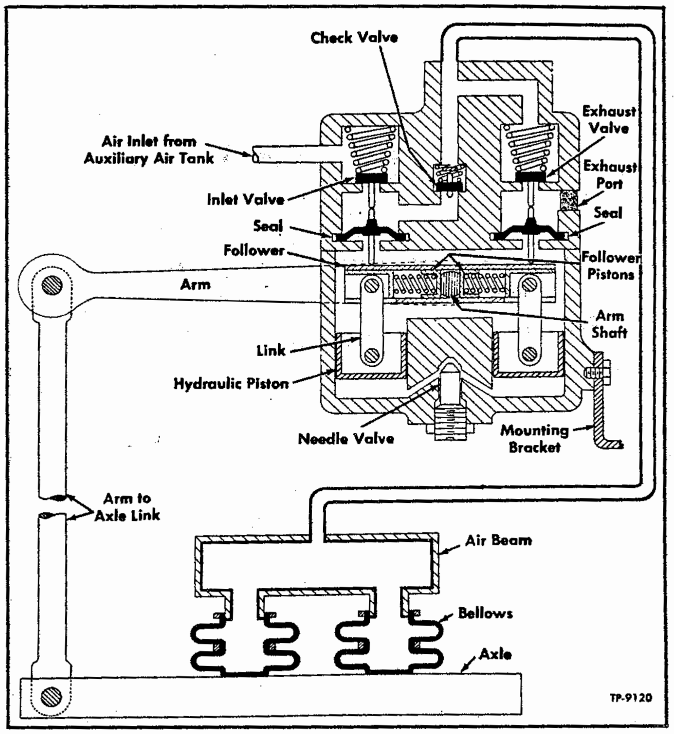


Figure 14—Schematic Diagram of Height Control Valve Labeled for Identification of Parts

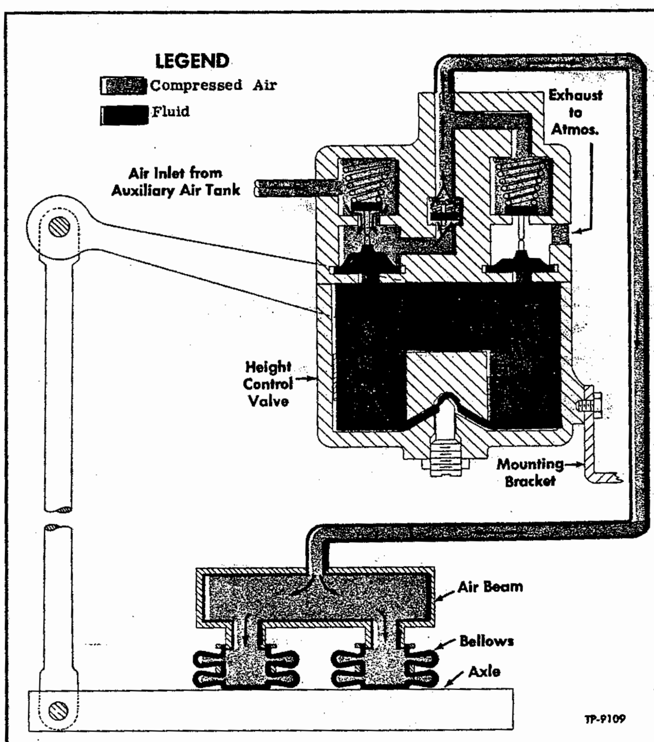


Figure 15—Operation of Height Control Valve in "Raising Body" Position

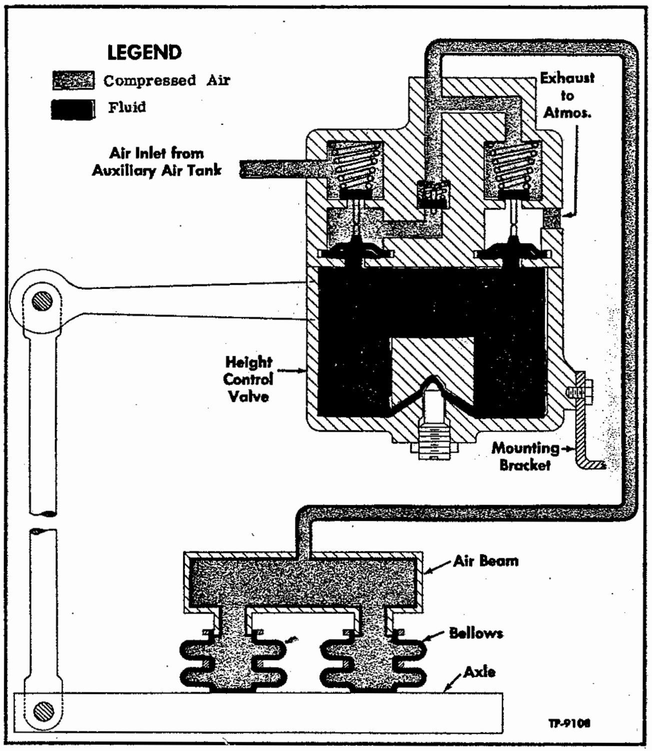


Figure 16—Operation of Height Control Valve in "Neutral" (Normal Height) Position

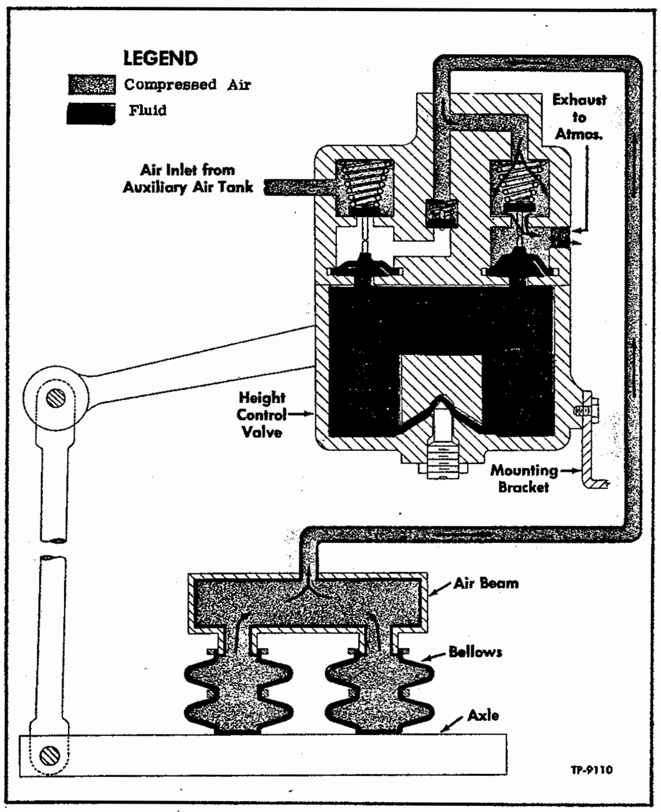


Figure 17—Operation of Height Control Valve in "Lowering" Position

spring pressure to close the inlet valve, stopping the flow of air pressure into the air beam, while the exhaust valve remains closed. Since the exhaust valve is closed, and the check valve in the inlet passage prevents air pressure from returning to the air tank, air pressure which has been admitted into the air beam and bellows is trapped, holding the coach body at its normal ride height. No further valve action or air pressure movement takes place until the load is increased or decreased, moving the control valve arm out of neutral position to actuate the valves.

Lowering Coach Body (Fig. 17)

When passenger load is decreased, the decreased weight permits air pressure in bellows to raise the coach body, causing the control valve arm to move downward from its neutral (horizontal) position as shown in figure 17. The movement of the follower, in attempting to maintain a position parallel to the arm, forces the exhaust valve off its seat, and the inlet valve remains closed. Air pressure from air beam and bellows then flows through the open exhaust valve into the exhaust cavity and out the exhaust port to atmosphere. As air pressure is exhausted from the elbows, the coach body lowers until the arm and follower are again in neutral (horizontal) position, and the condition described above under "Neutral Position" again prevails.

Control Valve Arm Free Travel

With vehicle in motion and body at normal ride height, control valve arm and follower are in neutral (horizontal) position as illustrated in figure 16. Small irregularities in road will cause slight up and down movement of control valve arm. Clearances are provided in valve operating mechanism to permit outer end of arm to move up or down 3/16" to 1/4" from its neutral position without causing any valve action. Thus small road bumps are absorbed by the tires and the bellows without causing any movement of compressed air into or out of the suspension system.

Hydraulic Delaying Action

The hydraulic portion of the height control valve is provided to delay the mechanical actuation of the valves when road irregularities cause axle movement to momentarily force the control valve arm beyond its free-travel position. Pistons in follower are spring-loaded against flat sides of control valve arm shaft. It is the pressure of these pistons against the flats on the shaft which causes the follower to attempt to maintain a position parallel to the control valve arm. A hydraulic piston is connected by a link to each end of the follower. These pistons must move up or down in their cylinder concurrently with the follower movement.

However, the piston traveling downward must displace the fluid below it through a restricted orifice into the cylinder below the other piston. This restriction limits the speed of the piston movement. Thus, when a road bump momentarily forces the control valve arm beyond its free-travel position and the arm immediately returns to neutral, the delaying action of the hydraulic pistons prevent the follower from moving immediately and actuating the air pressure control valves. The arm shaft merely turns between the follower pistons, compressing the piston springs.

HEIGHT CONTROL VALVE REMOVAL

Before disconnecting any air lines from either the front or rear height control valves, place blocking under coach at transverse bulkheads, or place blocks between axle bumpers and axles to hold body in raised position when air pressure is exhausted from air suspension system. Exhaust air pressure from auxiliary air system by opening drain cock in auxiliary tank, located in compartment at left front corner of vehicle. After the above precautions have been taken, remove height control valve as follows:

Front

1. Disconnect height control valve link from control valve arm, then pull arm down to exhaust air pressure from bellows and air beams.
2. Disconnect air supply line from elbow in air filter and check valve assembly at rear end of control valve. Disconnect control valve to air beam air lines from two air filters at front end of valve.
3. Remove two cap screws and lock washers attaching control valve to mounting bracket and remove control valve assembly.
4. Remove air filter and check valve assembly and two air filter assemblies from control valve for installation on replacement unit.

Rear

This procedure covers removal of either the right or left side height control valve assembly.

1. Disconnect height control valve link from control valve arm, then pull arm down to exhaust air pressure from bellows and air beam.
2. Disconnect air supply line from air filter and check valve assembly at outer end of control valve. Disconnect both ends of control valve to air beam air line, then remove air line assembly.
3. Remove four nuts, lock washers, flat washers, and bolts attaching control valve mounting bracket to bulkhead, then remove control valve and mounting bracket assembly.
4. Remove two cap screws and lock washers attaching mounting bracket to control valve body and remove bracket. Also remove air filter and check valve assembly with elbow and air line connector, and air filter assembly with two elbows from control valve for installation on replacement unit.

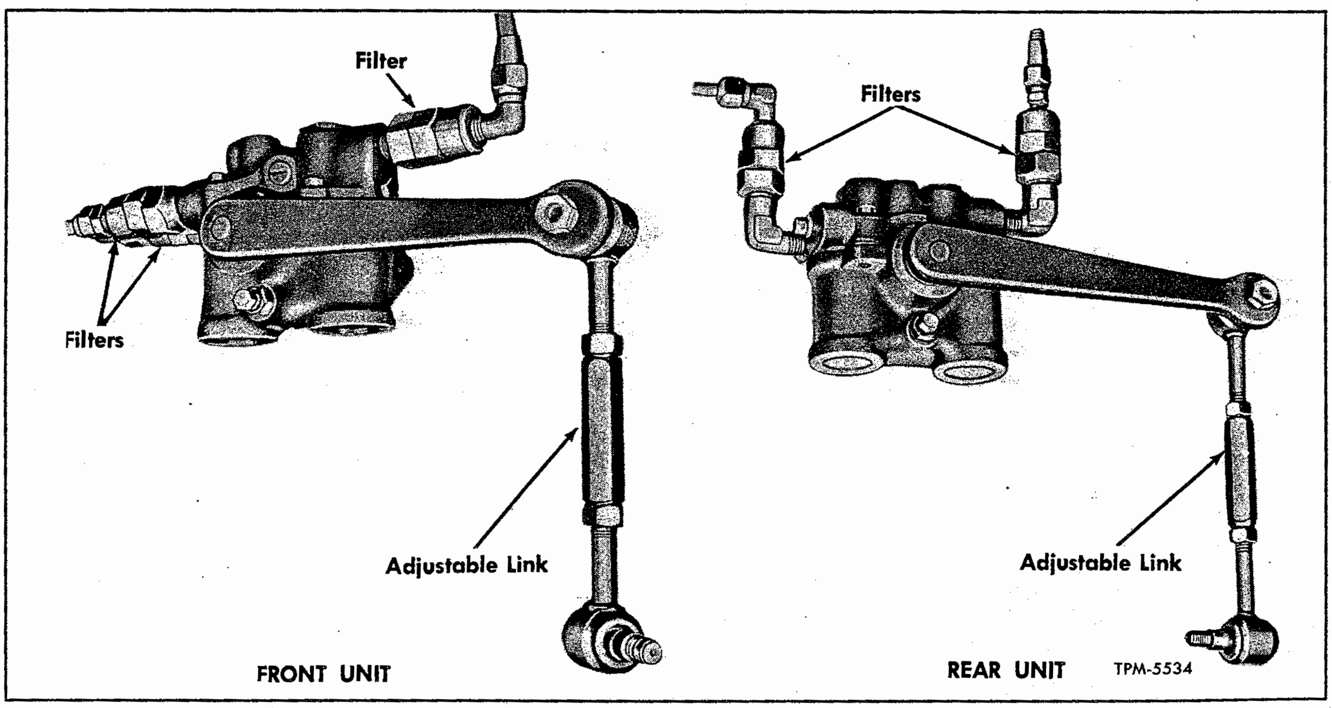


Figure 18—Height Control Valve

HEIGHT CONTROL VALVE INSTALLATION

Before installing either the front or rear height control valve assembly, inspect all air line fittings to make sure they are clean and not damaged. On connectors having rubber sleeves, replace sleeve if old one is deteriorated or damaged in any way. Service air filter assemblies as previously directed under "Air Filters" before assembling to height control valves.

IMPORTANT: Absolute cleanliness is essential when installing height control valves. No dirt or thread sealing compound must be permitted to enter the control valves. Even minute particles of foreign matter may become lodged on check valve or control valve seats and render the air suspension system inoperative.

Front

1. Using Permatex Aviation "Form-A-Gasket" number 3 on male threads, assemble air filter and check valve assembly to height control valve inlet port. Do not apply Permatex to first two threads. After tightening, elbow must point up as shown in figure 18. Assemble two air filter assemblies with connectors to control valve outlet ports (fig. 18), using Permatex mentioned above on male threads. Tighten firmly.
2. Position control valve assembly on mounting bracket and attach with two cap screws and lock washers. Tighten cap screws firmly.
3. Connect air supply line to elbow in air filter assembly. Connect control valve to air beam tube air lines to fittings at front end of control valve. Tighten all air line connector nuts firmly.
4. Connect height control valve link to control valve arm, build up air pressure in system, and accomplish air leakage tests as previously directed under "System Maintenance."

Rear

NOTE: Height control valves used at right and left sides are not interchangeable. Refer to "Specifications" at end of this section for identification of right and left side assemblies.

1. Using Permatex Aviation "Form-A-Gasket" number 3 on male threads, assemble air line elbows and connectors to air filter assembly as shown in figure 18. Do not apply Permatex to first two threads. Install these assemblies on height control valve, leaving parts positioned as shown in figure 18 when tightened.
2. Install control valve mounting bracket on control valve and attach with two cap screws and lock washers; flanged end of bracket must be at inlet end of valve with the flange pointing toward the valve as shown in figure 18. Tighten cap screws firmly.
3. Position valve and bracket assembly at bulkhead and attach bracket to bulkhead with four bolts, flat washers, lock washers, and nuts. Tighten nuts firmly.
4. Connect air supply line to air filter and check valve assembly. Install control valve to air beam air line. Tighten all air line connector nuts firmly.
5. Connect height control valve link to control valve arm, build up air pressure in system, and accomplish air leakage tests as previously directed under "System Maintenance."

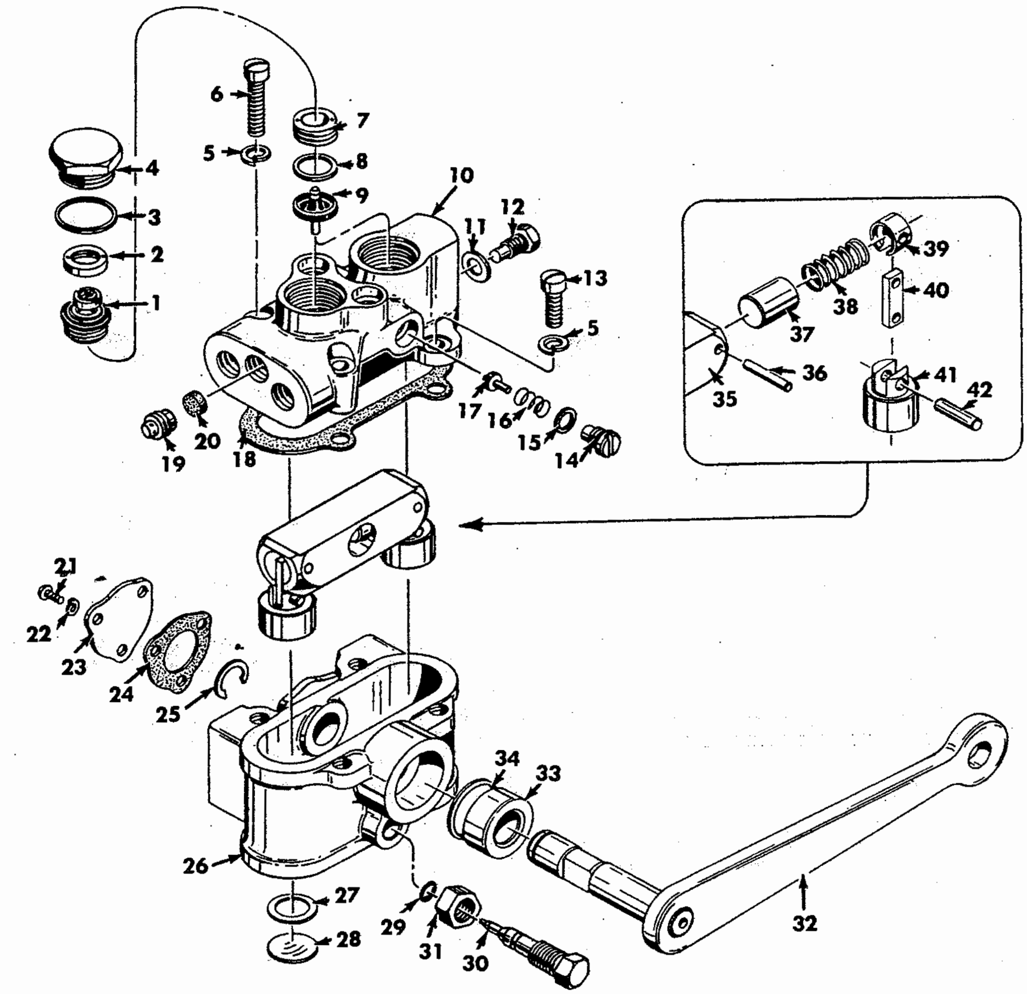
HEIGHT CONTROL VALVE OVERHAUL

Height control valves meter air into and out of the air suspension system. These valves must be precision built and accurately calibrated. Parts must be carefully handled and assembled and valves must be accurately adjusted to insure proper operation after rebuild. Special tools mentioned in text must be used. Improper tools may break off chips that could lodge between valves and seats. Chips, dirt, and other foreign material are most generally the cause of faulty valve operation. Every precaution should be taken to insure clean work.

DISASSEMBLY

Key numbers in text refer to figure 19.

1. Remove four screws (6 and 13) attaching valve housing (10) to damper body (26). Lift off valve housing and gasket (18).
2. Drain fluid out of damper body.
3. Remove two control valve cover nuts (4) and gaskets (3).
4. Using control valve lock nut wrench J-6049-7 (fig. 20), unscrew control valve lock nuts (2).
5. Remove two control valve assemblies (1), using control valve wrench J-6049-2) (fig. 20).
6. Using diaphragm lock nut wrench J-6049-8 (fig. 20), remove two diaphragm retaining lock nuts (7). Lift out diaphragm washers (8) and valve actuating diaphragm and plungers (9) with long-nosed pliers.
7. Remove check valve cover nut (14) and gasket (15). Remove check valve spring (16) and check valve (17).
8. Remove exhaust silencer retainer (19) and exhaust silencer (20).
9. Remove filler plug (12) and gasket (11).
10. Loosen needle valve lock nut (31), then remove needle valve (30) and "O" ring seal (29).
11. Remove three end cover screws (21) and lock washers (22). Remove shaft end cover (23) and gasket (24).
12. Turn actuating arm (32) to position at right angle to damper body. Tap lightly on arm end of shaft until shaft retaining ring (25) is exposed (fig. 21). Remove retaining ring from shaft.



1 Control Valve Assembly
2 Control Valve Lock Nut
3 Cover Nut Gasket
4 Control Valve Cover Nut
5 Lock Washer
6 Valve Housing to Damper Body Screw (Long)
7 Diaphragm Retaining Lock Nut
8 Diaphragm Retaining Washer
9 Valve Actuating Diaphragm and Plunger
10 Valve Housing
11 Plug Gasket
12 Fluid Filler Plug
13 Valve Housing to Damper Body Screw (Short)
14 Check Valve Cover Nut
15 Cover Nut Gasket
16 Check Valve Spring
17 Check Valve
18 Valve Housing to Damper Body Gasket
19 Exhaust Silencer Retainer
20 Exhaust Silencer
21 End Cover Screw
22 Lock Washer
23 Shaft End Cover
24 End Cover Gasket
25 Shaft Retaining Ring
26 Damper Body
27 Expansion Plug Gasket
28 Expansion Plug
29 Needle Valve "O" Ring Seal
30 Needle Valve
31 Needle Valve Lock Nut
32 Actuating Arm and Shaft
33 Shaft Seal
34 Seal Gasket
35 Cam Follower Beam
36 Beam to Link Pivot Pin
37 Cam Follower Tappet
38 Tappet Spring
39 Tappet Spring Retainer
40 Beam to Piston Link
41 Damper Piston
42 Link to Piston Pivot Pin

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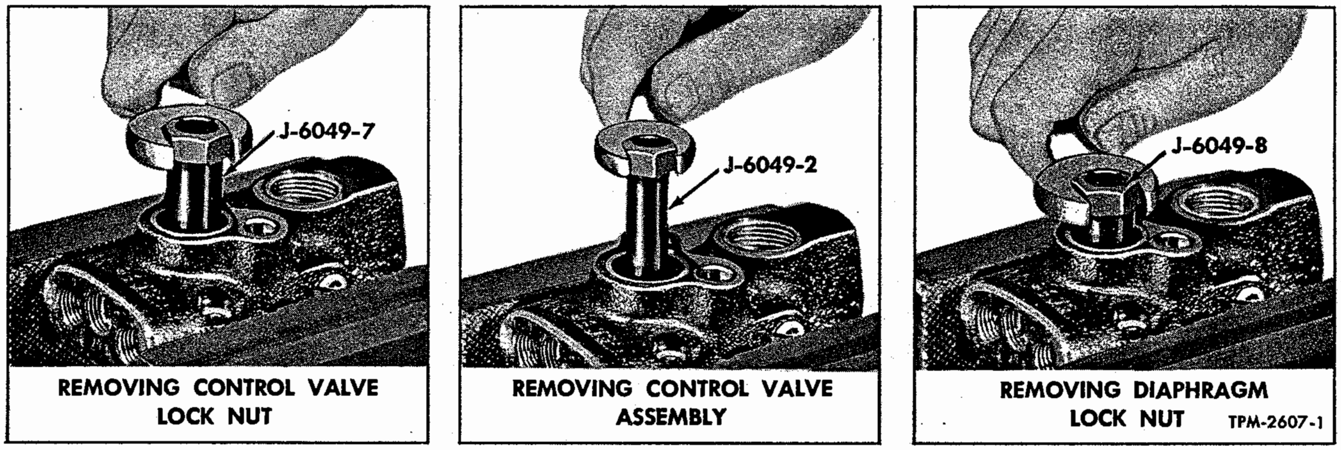
Figure 19—Height Control Valve Components



REMOVING CONTROL VALVE LOCK NUT

REMOVING CONTROL VALVE ASSEMBLY

REMOVING DIAPHRAGM LOCK NUT TPM-2607-1

Figure 20—Use of Special Height Control Valve Wrenches

13. With actuating arm still at right angle to body, support the body in vise jaws and drive out the shaft and arm assembly. Use remover and replacer J-6049-3 as shown in figure 22.

14. Lift out cam follower beam and piston assembly (35 through 42). Drive out pivot pins (36 and 42). Remove damper pistons (41), links (40), retainers (39), springs (38), and tappets (37) from cam follower beam (35).

15. Pry shaft seal (33) out of damper body and remove seal gasket (34).

16. Cylinder expansion plugs (28) should not be removed unless leakage is indicated.

CLEANING AND INSPECTION

Key numbers in text refer to figure 19.

1. The following parts should be discarded and replaced with new parts at each overhaul: Valve actuating diaphragm and plungers (9), control valve assemblies (1), gaskets (3, 11, 15, 18, 24, and 34), check valve (17), shaft seal (33), and needle valve "O" ring seal (29). Plug (28) and gasket (27) need not be replaced unless leaking.

2. Thoroughly clean all metallic parts in suitable cleaning solvent. Blow parts dry with compressed air. See that internal passages in valve housing and damper body are open.

3. Inspect all bearing and rubbing surfaces for scoring, fractures, or noticeable wear. Discard all damaged or worn parts and replace with new parts.

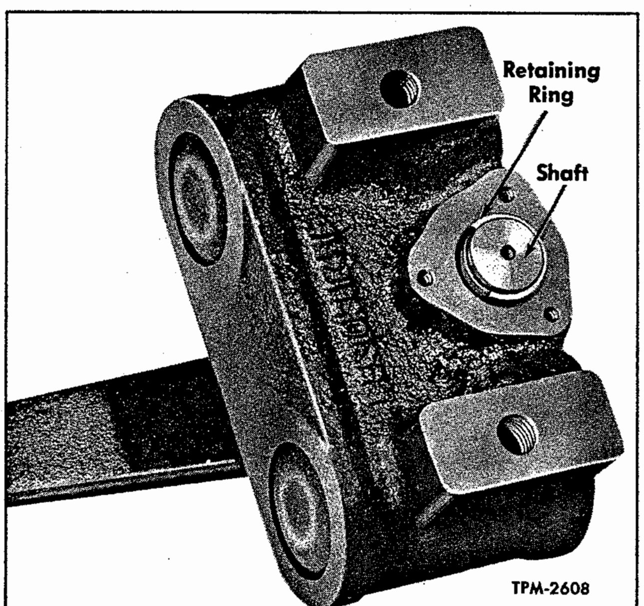


Figure 21—Shaft Retaining Ring Exposed

ASSEMBLY

Key numbers in text refer to figure 19.

While assembling height control valve components REMEMBER THAT ABSOLUTE CLEANLINESS IS ESSENTIAL.

1. If expansion plugs (28) have been removed, make certain machined seats in damper body are entirely free of sealing compound. Apply a thin coat of Permatex number 2 to both sides of gasket (27), then place gasket in seat. Place expansion plug (28) on gasket with crown side out, then upset plug in seat with a 1" round flat-end punch until crown of plug is flush to 1/32" below machined surface of casting.

2. Place seal gasket (34) in seal bore in damper body, then press shaft seal (33) into body against gasket.

3. Assemble cam follower beam and pistons (35 through 42) as follows:

a. Install tappet (37), spring (38), retainer (39), and link (40) in each end of cam follower beam (35) and secure in place with pivot pin (36).

b. Assemble piston (41) on each link (40) and secure with pivot pin (42). Stake both ends of all four pivot pins (36 and 42) to hold pins in place.

4. Insert the cam follower and piston assembly

in damper body and align shaft hole in follower beam (35) with shaft hole in body. Insert tapered end of remover and replacer J-6049-3 through shaft seal in body. Make sure end of tool enters between tappets (37), then drive tool in until round end of tool is flush with side of body.

5. Hold arm and shaft (32) at right angle to body. Place end of shaft on tool and drive the shaft through the seal, cam follower beam, and housing. Force out tool on opposite side as shown in figure 23.

6. Push shaft through body far enough to expose retaining ring groove and install retaining ring (fig. 21). Turn arm parallel to body, then pull shaft back until tappets snap against flats on shaft.

7. Install shaft end cover (23) and gasket (24) and secure with three screws (21) and lock washers (22).

8. Install "O" ring seal (29) on needle valve (30). Thread needle valve carefully into damper body until seated, then back off two turns. Tighten lock nut (42) finger-tight.

9. Place actuating diaphragm and plungers (9) in valve housing and secure with retaining washer (8) and lock nut (7). Use wrench J-6049-8 to tighten lock nut to 30 inch-pounds torque. NOTE: Torque in excess of 30 inch-pounds may damage diaphragm.

10. Insert check valve (17) into valve housing. Secure with spring (16), gasket (15), and cover nut (14). Tighten cover nut to 144 inch-pounds torque.

11. Install exhaust silencer (20) in valve housing and secure with retainer (19). Tighten firmly.

12. Place gasket (18) on damper body, then position valve housing on body. Filler hole must be located at rear of height control valve when valve is mounted either at left or right of vehicle.

13. Install screws (6 and 13) with lock washers (5) and attach valve housing to damper body. Tighten screws to 75 inch-pounds torque.

14. Mount height control valve on holding fixture J-6049-4 with two 3/8"-24 x 3/4" bolts. Support the assembly in a vise with filler hole up and pour hydraulic oil into filler hole. Use hydraulic oil which conforms to Military Specification MIL-O-5606. Pump actuating arm slowly to expel air. When completely filled, install filler plug (12) with gasket (11) and tighten to 120 inch-pounds.

15. Thread lock nuts (2) onto control valve assemblies (1) finger tight and insert these two assemblies into threaded cavities in valve housing. Start valve in threads, using wrench J-6049-2, but do not turn in. Cover nuts (4) and gaskets (3) are not to be assembled until valve opening has been adjusted.

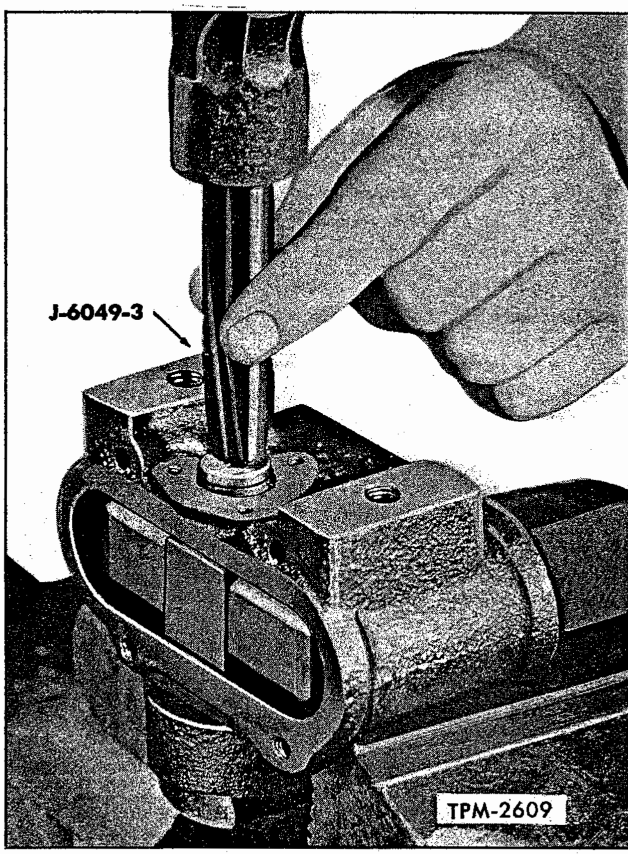


Figure 22—Using Special Tool to Drive Out Shaft

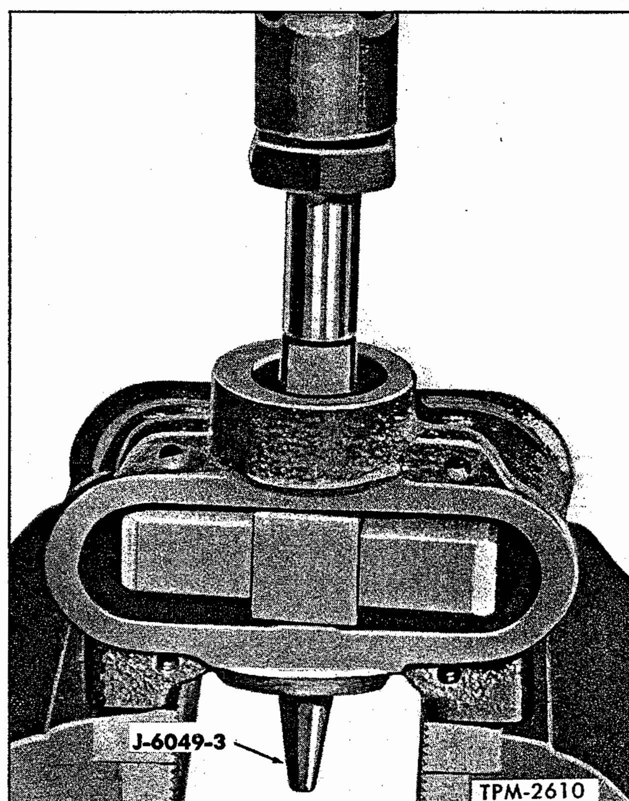


Figure 23—Installing Arm and Shaft

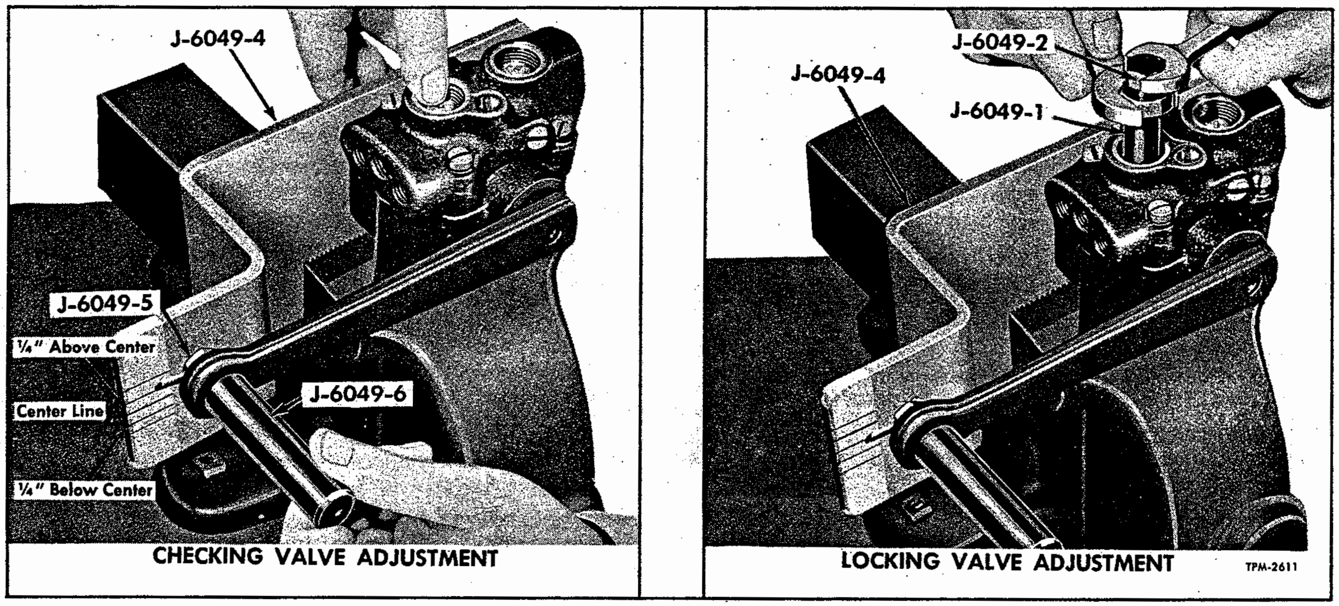


Figure 24—Calibrating Height Control Valve

CALIBRATION AND TESTING

Key numbers in text refer to figure 19.

With the height control valve still mounted on fixture J-6049-4 and with fixture clamped in vise with valve in operating position, adjust and test as follows:

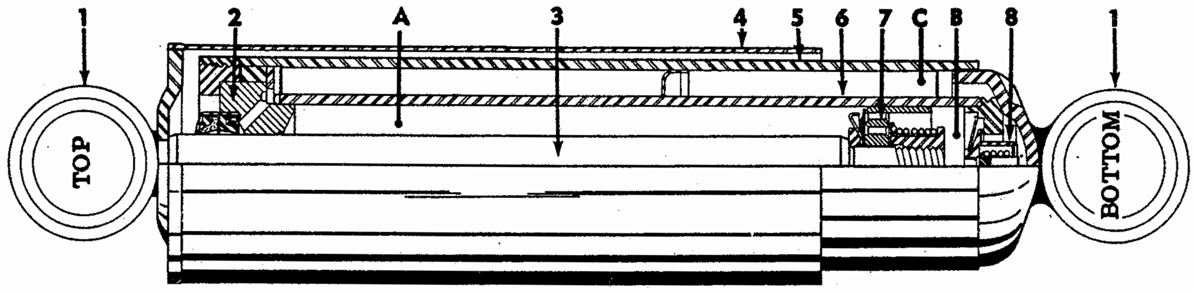
1. Turn the actuating arm to the left-hand horizontal position. Fasten a strip of white paper or masking tape on holding fixture at outer end of arm.
2. Move actuating arm slowly upward until a definite stop is felt. Repeat several times to confirm position. With arm at this stop position, mark paper at upper edge of arm.
3. Repeat step 2 for downward stroke.
4. Measure distance between the two marks and make a horizontal center line exactly between. This is the mid-position or neutral position of the arm.
5. Scribe a line 1/4" above and parallel to the center line and another 1/4" below (fig. 24). At these points, the valves should start to open.
6. Using wrench J-6049-2, screw in left-hand valve assembly (1) about one turn.
7. Insert finger nail in screw slot of valve to make contact with top of brass valve plunger (fig. 24).
8. Raise actuating arm until contact of operating beam is felt on plunger and note position of pointer (fig. 24). If pointer is above the "1/4-inch above center" line, continue screwing valve in until contact is made at the proper point. If pointer is below the "1/4-inch above center" line when contact is made, back off valve until contact is made at proper point.
9. When correct valve position has been determined, insert wrench J-6049-2 inside wrench J-6049-7 and tighten valve lock nut (2) while holding valve (1) in position as shown in figure 24.
10. Install valve cover nut (4) with gasket (3) on top of left-hand valve and tighten nut to 600 inch-pounds torque.
11. Repeat steps 6 through 10 with right-hand valve. Make calibration at "1/4-inch below center" line.
12. Connect an air line to height control valve and test inlet valve for operation and leakage.
13. Change air line connection to outlet side of valve and repeat step 12.
14. Adjust needle valve (30) until the opening of the intake or exhaust valve is delayed 3 to 7 seconds following a rapid 2-inch arm movement in each direction starting from a point 1 inch above or below the center line.

SHOCK ABSORBERS

DESCRIPTION

Shock absorbers used at front and rear axles are double-acting aircraft type. The principal components of the shock absorber, illustrated in figure 25 are: Piston and valving assembly (7), piston rod (3), guide rod and seal assembly (2), cylinder tube (6), base valving assembly (8), reservoir tube (5), shield (4), and mounting eyes (1). The cylinder tube (6) is completely filled with special hydraulic fluid, with an additional amount in the reservoir tube.

Front and rear shock absorbers are identical



1 Mounting Eyes
2 Rod Guide and Seal Assembly
3 Piston Rod
4 Shield
5 Reservoir Tube
6 Cylinder Tube
7 Piston and Valving Assembly
8 Base Valving Assembly

TP-9107

Figure 25—Sectional View of Shock Absorber

in appearance and size, however, they are not interchangeable. Internal valving for front and rear units are different, and it is important that the correct shock absorber be used at front and rear. Part number, model number, and valve code are stamped on each unit, and reference should be made to "Specifications" at end of this section to make sure the correct unit is being used.

SHOCK ABSORBER OPERATION

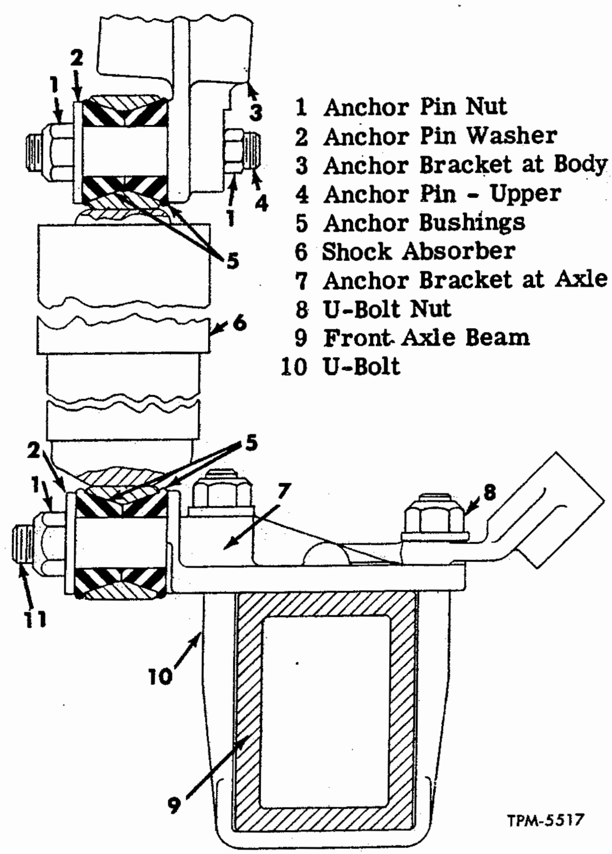
Starting with the shock absorber in closed position as illustrated in figure 25, the control of the opening or "rebound" stroke is as follows: As the piston assembly (7) travels upward, the fluid is compressed in the top portion (A) of the cylinder tube (6) and is forced through orifices in the piston and the rebound control valving located in the bottom of the piston. To replace fluid displaced by the piston rod (3) when in closed position, fluid is drawn from the reservoir section (C) in the reservoir tube (5) through the intake valve section of the base valve (8) into the lower portion (B) of the cylinder tube (6).

The closing or "compression" stroke of the shock absorber is controlled as follows: Fluid pressure for control of the compression stroke is developed entirely by the displacement of the piston rod (3) as it enters the fluid-filled cylinder tube (6). The piston (7) does not function, (as a piston), during this cycle since fluid is by-passed from section (B) to section (A) of the cylinder tube (6) through the check valve located in top of piston. The check valve opens on the compression stroke and closes on the rebound stroke.

The fluid displaced by the piston rod (3) entering the cylinder tube (6) is expelled through an orifice in the base valve (8) into the reservoir (C). However, as the velocity of movement increases, the pressure will build up faster than the orifice can bleed it out. When the pressure overcomes the force of the spring in the relief valve section of the base valve, the relief valve lifts from its seat, permitting greater flow and maintaining the internal pressure at the predetermined limit.

SHOCK ABSORBER SERVICE

Due to the construction of the shock absorbers, special tools and testing equipment are required



1 Anchor Pin Nut
2 Anchor Pin Washer
3 Anchor Bracket at Body
4 Anchor Pin - Upper
5 Anchor Bushings
6 Shock Absorber
7 Anchor Bracket at Axle
8 U-Bolt Nut
9 Front Axle Beam
10 U-Bolt

TPM-5517

Figure 26—Shock Absorber Mounting (Front Shown)

for servicing and overhauling. Malfunctioning shock absorbers must be replaced with new parts.

SHOCK ABSORBER REMOVAL (Fig. 26)

Remove nuts and washer from shock absorber upper and lower anchor pins. Pull shock absorber and rubber bushings off anchor pins.

SHOCK ABSORBER INSTALLATION (Fig. 26)

Refer to "Specifications" for model and valve code numbers to be sure correct unit is being installed. Make sure shock mounting eyes and anchor pins are clean. Place one rubber bushing on each anchor pin, install shock absorber eyes over anchor pins, then install second rubber bushing, washer, and nut on each anchor pin. Use No. 110 Lubriplate on threads. Tighten nuts to torque listed in "Specifications."

SPECIFICATIONS

AIR BELLOWS	
RIDE HEIGHT	
Front	3"
Rear	3-1/4"
Make	Firestone Industrial Products Co.
Material	Rubber
Maximum Pressure	75 psi
HEIGHT CONTROL VALVES	
Make	Delco Products
Model Number (Stamped on Valve Cap)	
Front	5518488
Right Rear	5352873
Left Rear	5352874
SHOCK ABSORBERS	
FRONT	
Make	Delco Products
Type	Double-Acting, Telescoping
Identification (Stamped on Unit)	
Part Number	5316984
Model Number	450W
Valve Code	2N10/J13
Collapsed Length*	16-5/8"
Extended Length*	26-5/8"
Travel	10"
REAR	
Make	Delco Products
Type	Double-Acting, Telescoping
Identification (Stamped on Unit)	
Part Number	5352857
Model Number	450W
Valve Code	3L10/J3
Collapsed Length*	16-5/8"
Extended Length*	26-5/8"
Travel	10"

* Length measured from center to center of mounting eyes.

TORQUE SPECIFICATIONS

	DRY	LUB.
Radius Rod Anchor Plate Bolt Nuts (Lbs. Ft.)	400-425	300-325
Radius Rod Anchor Pin Stud Nuts or Cap Screws (Lbs. Ft.)	360-385	275-300
Shock Absorber Anchor Pin Stud Nuts (Lbs. Ft.)	400-425	300-325
Rear Axle to Suspension Support U-Bolt Nuts --(7/8" Lbs. Ft.)	400-450	
(1-1/8" Lbs. Ft.)	750-800	
Front Axle Suspension Support Stud Nuts (Lbs. Ft.)	400-425	300-325
Front Suspension Support and Shock Absorber Anchor Bracket U-Bolt Nuts (Lbs. Ft.)	225-250	175-200

Steering System

> This group includes maintenance information on both mechanical and power steering system used on coaches covered by this manual. The power units used in conjunction with the conventional driving gear units are covered under "Power Steering" later in this section. All other information applies to both systems with exceptions noted in text.

Two types of steering mechanism are used on these vehicles - conventional mechanical as standard equipment and power steering as special equipment.

Steering mechanism comprises the steering column assembly with wheel and bevel gear unit, steering gear assembly, steering propeller shafts and support bearing, and associated axle parts.

When power-steering equipped, a booster cylinder assembly is added at front axle, also a power steering pump at engine, with hydraulic fluid lines between pump and booster cylinder.

Steering column assembly consists of steering wheel, upper and lower column shafts with connecting universal joint, and bevel gear housing assembly (fig. 1).

Steering gear assembly is cam and lever, twin roller type (fig. 5). The only contact between actuating and actuated members of gear is the rolling contact between lever studs and the worm (cam) groove. Clearance between lever studs and worm groove is adjustable by means of a lever shaft adjusting screw, also worm bearings are adjustable by shims, as described in this section.

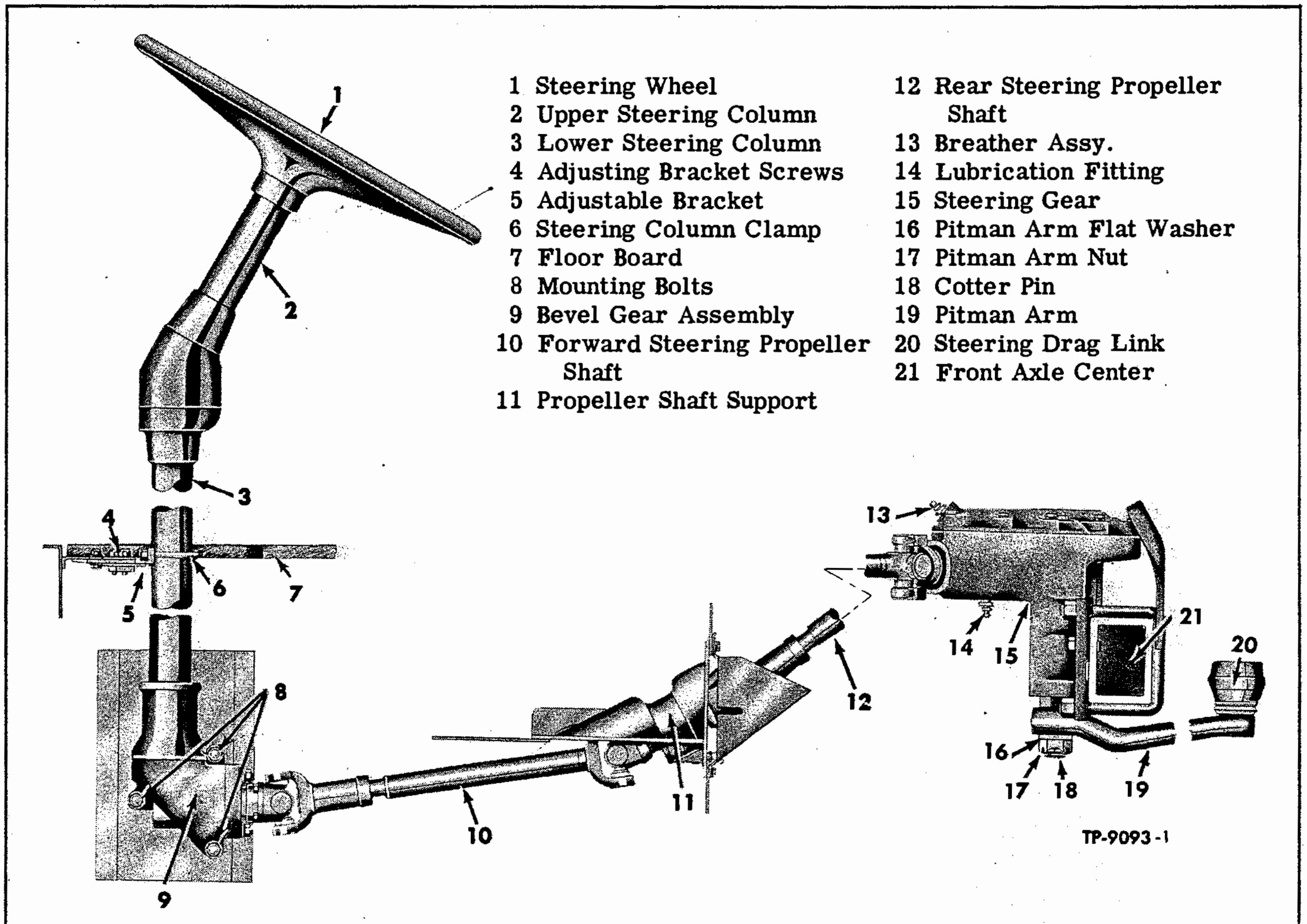
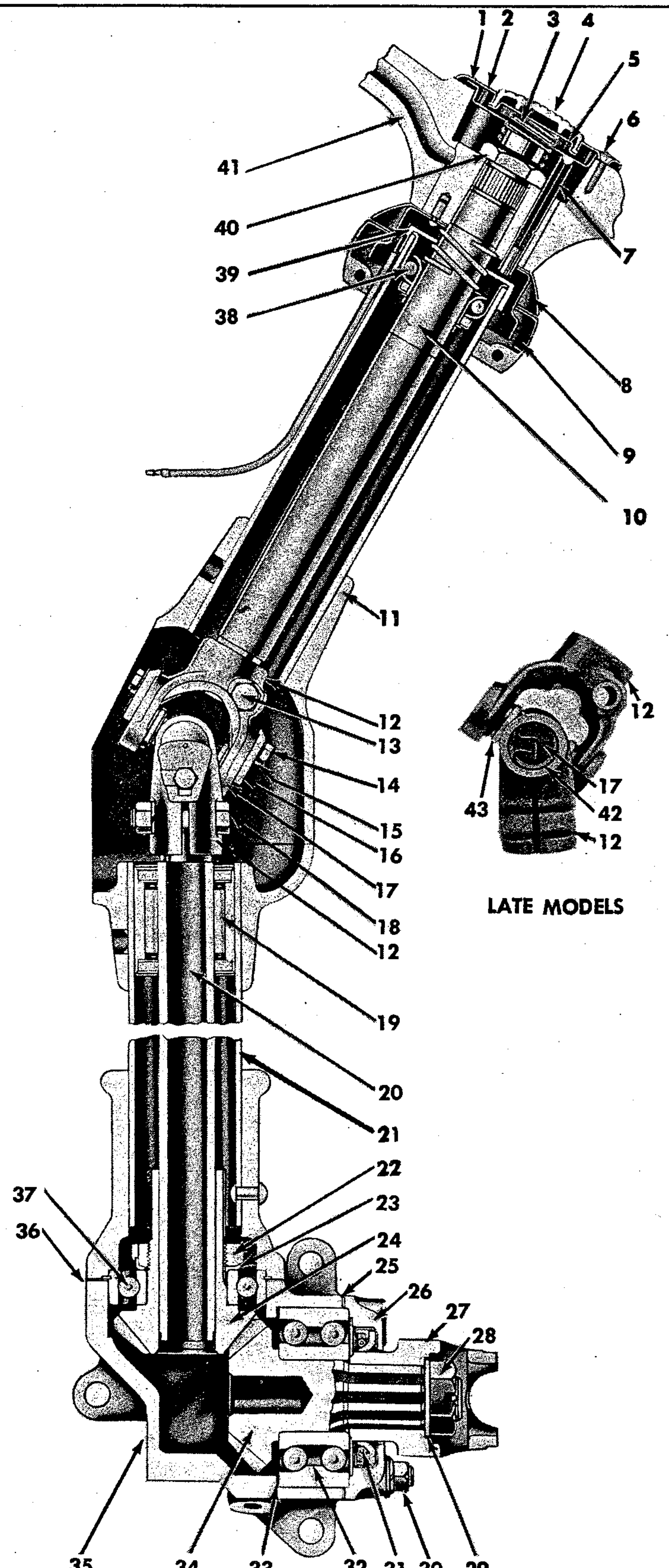


Figure 1—Steering System Units (Without Booster)



1 Insulator Gasket
2 Horn Button Retainer
3 Horn Button Spring
4 Horn Button
5 Horn Button Plate
6 Retainer Screw
7 Horn Contact and Brush
8 Directional Signal Switch Shield
9 Directional Signal Switch Assembly
10 Upper Shaft
11 Upper Housing Assembly
12 Yoke
13 Upper Clamp Bolt
14 Bolt
15 Lock Plate
16 Bearing Retainer Plate
17 Bearing
18 Lower Clamp Bolt
19 Lower Column Bearing
20 Lower Shaft
21 Lower Housing Assembly
22 Lock Nut
23 Locking Washer
24 Upper Bevel Gear
25 Retainer Gasket
26 Bearing Retainer
27 Yoke
28 Retaining Nut
29 Retaining Washer
30 Stud Nut
31 Oil Seal Assembly
32 Bearing
33 Adjusting Shims
34 Lower Bevel Gear
35 Gear Housing
36 Adjusting Shims and Gasket
37 Bearing
38 Upper Column Bearing
39 Contact and Cable Assembly
40 Steering Wheel Nut
41 Steering Wheel
42 Snap Ring
43 Seal

Figure 2—Steering Column and Bevel Gear

OPERATION

Operation of steering system is essentially the same as a conventional type, except that steering gear is mounted on front axle. Steering effort is therefore transmitted from bevel gear unit to steering gear through steering propeller shaft (fig. 6). Movement of steering gear lever shaft is transmitted to front wheels through pitman arm, drag link, steering knuckle arm, and tie rod.

ADJUSTMENTS

Before any of the following steering gear adjustments are accomplished, other factors which might cause unsatisfactory steering should be checked. Before attempting steering gear adjustments it should first be determined that front axle is properly located and that front wheel bearings are in proper adjustment.

CAM BEARING ADJUSTMENT

1. Loosen lock nut (17, fig. 5), then thread lever shaft thrust adjusting screw (16, fig.5) outward so to free lever shaft bearing stud in cam groove.
2. Remove four cap screws and lock washers, then clip and remove one of the thin shims (1) between cover and housing. Shims are available in 0.001", 0.002", 0.003", and 0.010" thickness.
3. Install and tighten four cap screws previously removed, then test adjustment by turning camshaft by hand. Proper adjustment provides that a barely perceptible drag can be felt when turned by hand. If cam shaft does not turn freely the adjustment is too tight and shims (1) should be added between housing and cover.

LEVER SHAFT THRUST ADJUSTMENT

Since most driving is done when traveling in an approximately straight line, more wear occurs in steering gear within about one quarter steering wheel turn either side of straight ahead position. Within this range, worm shaft groove is narrower than elsewhere, making it possible to adjust gear for wear without binding in extreme positions. Lever shaft thrust adjustment must be made with lever shaft in positions where width of worm shaft groove is narrowest; that is, within one-half steering wheel turn of straight ahead driving position.

Lever shaft thrust adjustment is made by means of an adjusting screw (16, fig. 5) located in side cover. Be sure worm shaft bearings are properly adjusted, then proceed as follows:

1. Disconnect drag link at Pitman arm.
2. Center steering gear by turning steering wheel from extreme right to left, carefully counting number of turns; then, rotate steering wheel back exactly half way. Mark wheel at top or bottom.
3. Loosen lock nut on adjusting screw (16), then tighten adjusting screw until all lever shaft end thrust is removed.
4. Back off thrust adjusting screw (16) until only a very slight drag can be felt near the straight ahead position, when turning steering wheel slowly from one extreme position to the other.

NOTE: On vehicles equipped with power steering, drag should be practically nil. In some cases, readjustment may be necessary after road test to provide satisfactory steering.

5. Tighten lock nut (17) securely and again test adjustment to make sure that lever shaft thrust did not change when lock nut was tightened.
6. When properly adjusted, lever shaft will have a slight amount of thrust. A closer adjustment will not correct any steering difficulties, and will only serve to wear parts more rapidly and impair operation. When adjustment is completed connect steering drag link to pitman arm.

STEERING WHEEL REPLACEMENT

Following instructions will apply regardless whether steering column is removed or remains installed in vehicle.

REMOVAL (Fig. 2)

1. Remove three horn button retaining screws (6) attaching button retainer to steering wheel. Lift retainer (2), insulator gasket (1), horn button (4), plate (5), and spring (3) from steering wheel, then lift connector, sleeve and brush assembly (7) out of wheel.
2. Remove steering wheel retaining nut (40). Use suitable steering wheel puller in manner typically illustrated in figure 3, pull steering wheel from upper shaft.

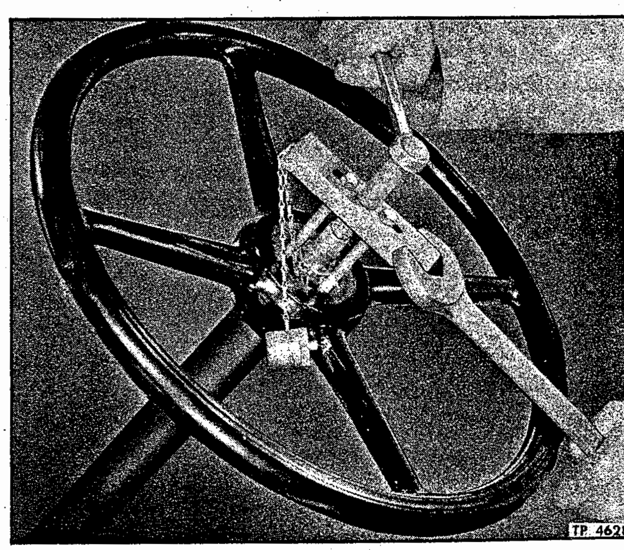


Figure 3—Steering Wheel Removal

INSTALLATION (Fig. 2)

1. Install woodruff key into keyway in shaft. Position directional signal switch shield on bottom of steering wheel hub. Install wheel on shaft, with woodruff key engaging keyway in wheel hub. Install steering wheel retaining nut and tighten securely to press wheel onto shaft.

2. Install connector, sleeve, and brush assembly (7) in wheel. Install spring (3), plate (5), horn button (4), insulator gasket (1), and retainer (2) to steering wheel and secure with three retaining screws (6).

STEERING COLUMN AND BEVEL GEAR

STEERING COLUMN REPLACEMENT

Whenever steering column and bevel gear unit assembly requires service which requires disassembly the entire assembly can be readily removed. References in following replacement procedures refer to figure 1.

REMOVAL (Fig. 1)

1. Remove directional signal switch assembly from steering column by removing screws holding halves of switch housing to steering column.

2. Remove metal screws attaching two closure plates to floor at steering column. Remove nuts and lock washers from steering column U-bolt under body floor.

3. Open door at left front corner of coach to gain access to lower column.

4. Lift latch and raise steering drive shaft protection shield, as bolts and nuts are removed from two U-bolts attaching drive shaft to bevel gear unit. Slide universal joint toward rear.

5. Remove nuts and washers from three bolts attaching bevel gear to mounting brackets. NOTE: Heads of three mounting bolts are accessible through button plug openings inside tire carrier compartment.

6. Complete steering column and bevel gear can now be lifted straight up to complete removal operations.

INSTALLATION (Fig. 1)

1. Position steering column and bevel gear assembly downward through opening in body floor.

2. Install three bolts, plain washers, lock washers, and nuts attaching bevel gear housing to mounting brackets. Loosen two cap screws attaching steering column clamp plate to support plate, then tighten three bevel gear mounting bolts.

3. Install steering column clamp and tighten clamp nuts securely. With mounting bolts tightened and column clamp installed, the two clamp plate cap screws, which were previously loosened, should now be tightened.

4. Connect steering drive shaft to bevel gear assembly and secure with two U-bolts, being sure that U-bolt nuts are tightened securely.

5. Install floor plates around steering column on body floor and secure with six metal screws.

6. Install directional signal switch assembly on steering column.

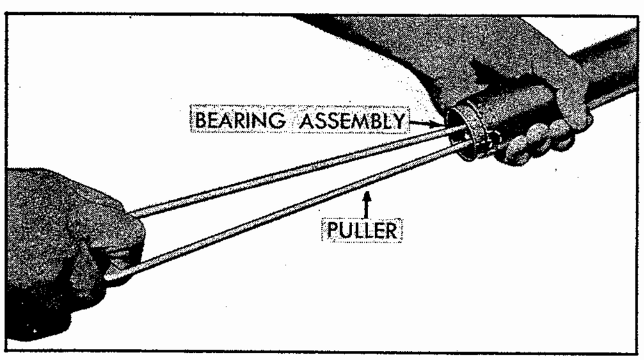


Figure 4—Upper Column Bearing Removal

STEERING COLUMN AND BEVEL GEAR DISASSEMBLY
(Refer to Figure 2)

Whenever steering column and bevel gear unit assembly requires service which necessitates disassembly the entire assembly can be readily removed as previously instructed.

1. Remove horn button and steering wheel as previously instructed under "Steering Wheel Replacement" in this section.

2. Remove four screws connecting upper and lower halves of steering column universal joint housing. Lift upper housing and column assembly from lower housing.

3. Remove horn contact and cable assembly (7) from upper steering column. Remove upper column bearing assembly (38), using suitable tool in manner illustrated in figure 4.

4. Loosen two clamp bolt nuts and remove universal joint assembly from upper and lower steering column shafts.

5. Remove four nuts, lock washers, and plain washers from studs attaching lower steering column housing (21) to bevel gear housing (35). Remove lower steering column and housing assembly (21) from lower steering shaft. Remove lower column bearing assembly (19), using suitable tool in manner illustrated in figure 4.

6. Lift shim pack (36) and gasket, used between lower column housing and bevel gear housing, and tag for identification at assembly.

7. Lift steering shaft, bearing, and upper bevel

gear assembly out of bevel gear housing. Remove bearing retaining nut (22) and nut lock washer (23) from bevel gear and shaft, then remove bearing (37) from bevel gear.

8. Remove cotter pin, nut (28) and washer (29) from lower bevel gear, then pull yoke (27) from gear.

9. Remove four stud nuts (30) lock washers, and flat washers attaching bearing retainer (26) to bevel gear housing then remove retainer and seal assembly. Remove oil seal (31) from bearing retainer.

10. Remove lower bevel gear and double row ball bearing assembly from bevel gear housing. Remove adjusting shims (33) from bevel gear housing and tag for identification at assembly.

UNIVERSAL JOINT DISASSEMBLY

ALL TYPES (Figure 2)

1. On some coaches bend lock plate and remove bolt, lock plate, bearing retainer plate. If bearings are retained with snap rings remove snap rings.

2. Using soft hammer drive journal sideways and drive one bearing out of yoke. Turn universal joint over and drive journal in opposite direction to remove bearing from yoke. NOTE: Rollers will drop out of bearing. Use care to prevent damage or loss of rollers.

3. Remove journal from yoke, then remove four gaskets and retainers.

CLEANING AND INSPECTION

CLEANING

Immerse all parts in cleaning fluid to loosen all deposits of dirt or old lubricant. Repeat immersion and brushing with soft bristle brush until all parts are thoroughly clean. Remove any particles of gasket remaining on bolting surfaces.

INSPECTION

1. Inspect steering shafts for bent or twisted condition, also for defective splines and keyways.

2. Examine bevel gears for worn, chipped, or broken teeth, also for damaged splines. Replace with new parts if defective.

3. Inspect all bearings for worn or damaged condition, such as flat spots on balls or damaged races. Replace with new parts if damaged.

4. Inspect lower bevel gear flange and oil seal lip for roughness at seal contact area on flange also seal lip for cut, worn, or deteriorated conditions. Replace with new seal if damaged. Flange can sometimes be cleaned up with fine emery cloth, otherwise replace with new part.

5. Check needle bearings on universal joint, outer race, and journal for wear, or damage. Pack bearing one-third full of grease to retain rollers, then install on journal to check fit on journal. If excessive clearance is evident, replace bearing or journal as necessary.

6. Always use new gaskets and lock plates (if used) when assembling.

UNIVERSAL JOINT ASSEMBLY

ALL TYPES (Figure 2)

1. Install four retainers and gaskets on journal arms.

2. Position journal arms in yoke, then press bearing assembly into two opposite journal arms. If snap rings are used, install snap rings. If bearing retainer plate, lock plate and bolts are used install same in same sequence as mentioned above.

3. Repeat above procedure for two opposite journals.

4. Universal joint is now assembled and ready to install between upper and lower steering column shafts.

STEERING COLUMN AND BEVEL GEAR ASSEMBLY (Fig. 2)

1. Install single row ball bearing (37) on upper bevel gear (24) with bearing snap ring toward top of steering column. Install locking washer (23) and retaining nut (22) tighten nut firmly, then bend ear of locking washer up against nut.

2. Install original shim pack (36) over studs in housing, with thin shims between thick shims. Place new gasket on top of shim pack. NOTE: Shims are 0.003" and 0.010" thick and approximately three each are usually required.

3. Place steering shaft and upper bevel gear assembly into bevel gear housing, with bearing snap ring resting on shim pack and gasket.

4. Pack lower column bearing (19) assembly with chassis grease then install bearing into upper end of lower steering column tube. Install lower steering column tube assembly over lower steering shaft and onto bevel gear housing. Install four each flat washers, lock washers, and nuts on studs and tighten evenly and securely.

5. Install original shim pack (33) into bevel gear housing, being careful that shims are seated evenly on shoulder in housing and that thin shims are between thick shims. NOTE: Shims are 0.003" and 0.010" thick and approximately three each are usually required.

6. Install double row ball bearing (32) on lower bevel gear (34). Install gear and bearing assembly in bevel gear housing with upper and lower bevel gears in mesh.

7. If new seal (31) is being installed in bearing retainer outer edge of seal should be coated with Permatex or other similar sealer to prevent

lubricant leaks between seal and retainer. Press seal into retainer until seated then remove excess sealer. Coat lip of seal with "Lubriplate 100" or equivalent.

8. Install bearing retainer and seal assembly over studs and secure with four each plain washers, lock washers and nuts tightened evenly and firmly.

9. Check bevel gear backlash. Rotate bevel gears to be sure they do not bind at any point. If gears are meshed too tight, hard steering will result. If gears are loose, operation will be rough, noisy, and with excessive steering wheel play.

10. To adjust backlash, remove or add shims (33) behind double row ball bearing. Removing shims will decrease backlash while adding shims will increase backlash. Proper adjustment provides for smooth rotation of gears without binding and a minimum of backlash.

11. When correct adjustment is obtained, install drive shaft yoke (27) on lower bevel gear and secure with washer (29) and nut (28). Tighten nut and secure with cotter pin.

12. Install woodruff key in keyway of lower steering shaft, then install universal joint assembly and tighten clamp bolt securely. Install woodruff key in keyway of upper steering shaft, then install shaft in universal joint and tighten clamp bolt securely.

13. Apply a liberal coating of chassis grease to universal joint assembly. Install upper steering column tube and housing (11) to lower housing (21) then secure with four socket head set screws.

14. Pack steering shaft upper bearing assembly (38) with lubricant recommended in LUBRICATION (SEC. 13). Press bearing onto upper shaft and into upper tube until shoulder on outer race seats on top of tube. Install spring seat and spring on steering shaft.

15. Coat rubber with brake fluid, then install horn contact and cable assembly (7) to steering column.

16. Install steering wheel, also horn button as previously directed under "Steering Wheel Replacement" in this section.

STEERING GEAR HOUSING ASSEMBLY

Steering gear assembly, mounted on top of front axle, should be removed whenever service requirements make it necessary to disassemble the unit for inspection and replacement of parts.

Reference numbers in text following refer to figure 5, unless otherwise indicated.

REMOVAL

1. Remove steering propeller shaft from steering gear cam as directed under "Steering Propeller Shaft" in this section.

2. Disconnect adjustable link from height control valve as directed in AIR SUSPENSION (SEC. 14).

3. Disconnect steering drag link tapered end stud from steering gear pitman arm as directed under "Drag Link Removal" in this section.

4. Remove four nuts from two clips attaching steering gear assembly to front axle center, then remove two clips. NOTE: On power steering remove pitman arm stop plates.

5. Remove locating bolt and lock washer attaching gear assembly to axle center, then remove assembly.

INSTALLATION

1. Position gear assembly to front of axle center and attach with locating cap screw and lock washer.

2. Install two clips attaching gear assembly to axle, being sure that clip with height control bracket is used at right side. NOTE: On coaches equipped with power steering install pitman arm stop plates as shown in figure 14. With thin plate to left and thick plate to right, position stop plates 1/8" from clip as shown in figure 14.

Install clip nuts and tighten evenly and alternately, also tighten locating cap screw.

3. Connect steering drag link end to pitman arm as directed under "Drag Link Installation" in this section.

4. Connect height control valve adjustable link to bracket and if necessary adjust as directed in AIR SUSPENSION (SEC. 14).

5. Install steering propeller shaft to steering gear cam as directed under "Steering Propeller Shaft" in this section.

6. Lubricate as directed in "LUBRICATION" (SEC. 13).

DISASSEMBLY

1. Loosen lock nut (17) and turn lever shaft adjusting screw (16) out a few turns.

2. Place pan under assembly to catch lubricant then remove housing side cover (14) and gasket (18).

3. Remove cotter pin (30) nut (29) and flat washer (28), then pull pitman arm (27) from lever shaft using suitable puller.

4. Carefully withdraw lever shaft assembly from housing, then remove spring (20), washer (21), and spring seat (19) from housing or lever shaft.

5. To remove bearing unit assembly (15) from lever shaft, bend prong of lock washer away from nut, then remove nut. Remove bearing stud, inner race, and bearing rollers, by pressing stud from

inner race. Press outer race from lever shaft.

6. Remove cotter pin and nut (9), then remove propeller shaft yoke (8) using suitable puller.

7. Remove four cap screws (31) and lock washers attaching cover (2) and shim pack (1) to housing. Observe quantity and thickness of shim pack for reassembly reference.

8. Remove cover (2) from housing, then push camshaft and bearings from housing. Remove bearing assemblies (3 and 5) from each end of camshaft.

9. Using suitable tool, remove lever shaft bearings (22 and 24) from housing, also remove oil seals (7 and 25) from housing.

CLEANING AND INSPECTION

CLEANING

Immerse all parts in suitable cleaning fluid to loosen all accumulated dirt and lubricant deposits. Particular attention should be given bearings to be sure that they are cleaned of all foreign deposits.

INSPECTION

1. Inspect each bearing to determine if satisfactory for continued service. If bearing shows any evidence of wear or failure it should be replaced with new part.

2. Inspect cam grooves for roughness. Groove must be smooth and free from scores or rough spots.

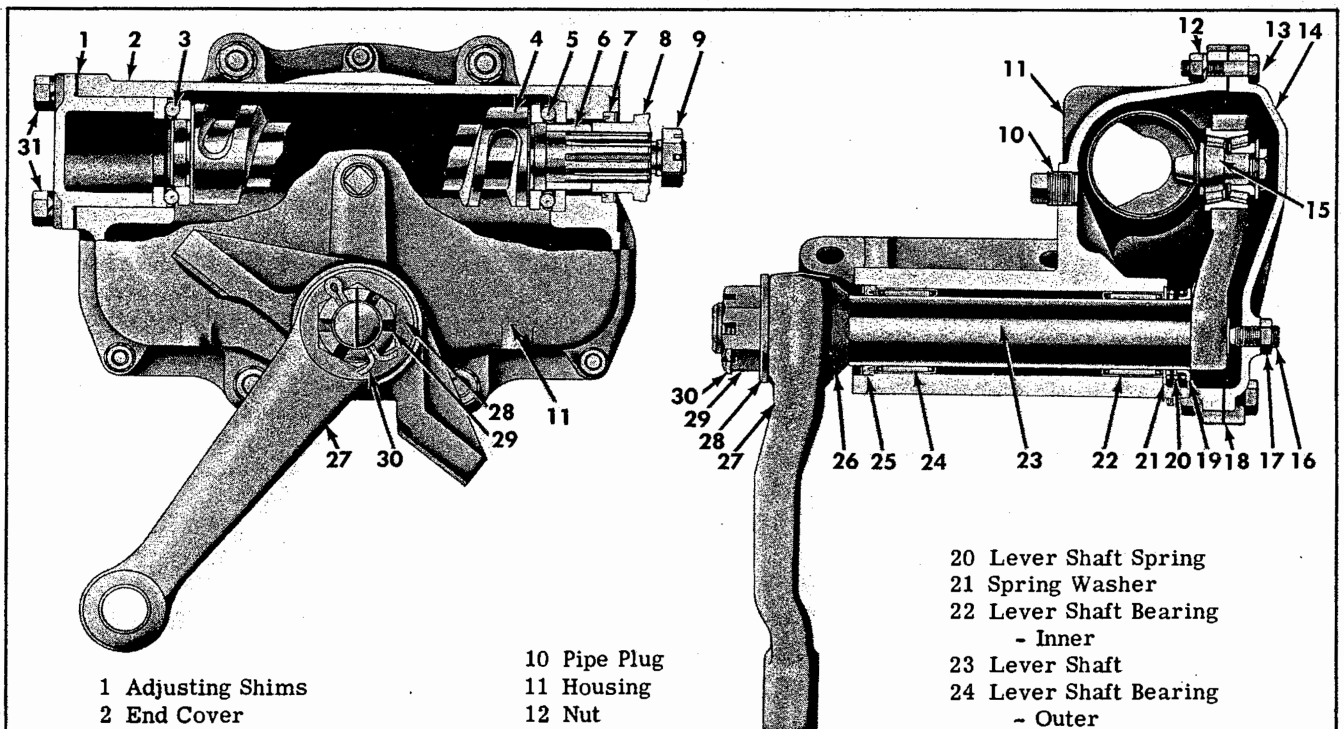
3. Inspect lever shaft for cracked, bent, or twisted condition, since any of these defects would render this part unsatisfactory for further use. Inspect area of shaft which contacts needle bearings and oil seal, and install new part if wear or roughness is evident.

4. Conical contact surfaces of lever shaft studs which ride in cam grooves must be smooth and free from scores and flat spots.

5. Inspect housing and side cover for cracks, distortion, or damaged tapped holes. Replace parts if damaged.

ASSEMBLY

Importance of cleanliness during assembly operations cannot be underestimated. Parts must be absolutely clean, since even the most minute particles of dirt will cause premature wear.



1 Adjusting Shims
2 End Cover
3 Camshaft Inner Bearing
4 Camshaft
5 Camshaft Outer Bearing
6 Camshaft Spacer
7 Oil Seal
8 Yoke
9 Nut
10 Pipe Plug
11 Housing
12 Nut
13 Cover Bolt
14 Housing Cover
15 Bearing Unit Assembly
16 Adjusting Screw
17 Lock Nut
18 Cover Gasket
19 Spring Seat
20 Lever Shaft Spring
21 Spring Washer
22 Lever Shaft Bearing - Inner
23 Lever Shaft
24 Lever Shaft Bearing - Outer
25 Oil Seal
26 Caulking Compound
27 Pitman Arm
28 Pitman Arm Flat Washer
29 Pitman Arm Nut
30 Cotter Pin
31 Cap Screws

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Figure 5—Steering Gear Housing Assembly

1. If removed, carefully press lever shaft bearings (22 and 24) into housing until bearing is flush with counterbore in housing.

2. Install new oil seals (7 and 25) at lever shaft and camshaft. Be careful that seals are seating squarely in housing and that lip of seal is not cut or damaged during installation.

3. Press two bearing inner race into pitman arm side of lever shaft. Coat inside of inner race with grease to hold bearing rollers in position during assembly. Install rollers, stud, inner race, locking washer, and nut into inner race.

4. Adjust stud roller bearing as follows:

a. Clamp lever and stud assembly in vise with jaws of vise gripped to straight cylindrical portion of stud. Use extreme care to prevent damage to stud bearing surface.

b. Rotate lever back and forth to seat bearings as nut is tightened to a heavy drag.

c. Remove assembly from vise and check adjustment. Proper adjustment provides 3 to 12 inch-pounds torque to turn stud.

d. When adjustment is within correct limits, lock adjustment by bending prong of locking washer against a side of the nut. Bend the prong that will bend flat against a side of the nut. Whenever a used washer is being installed the previously used prongs should be broken off.

5. Position cam shaft inside housing and install bearings (3 and 5) onto each end of shaft with small diameter bearing race toward cam. Push cam and bearings assembly into position in housing.

6. Position original shim pack (1) and cover (2) to housing and secure with four lock washers and bolts. Adjust end thrust of worm shaft by adding or removing shims (1) as directed under "Cam Bearing Adjustment" previously in this section.

7. Position lever shaft spring seat (19), spring (20), and spring washer (21) over lever shaft and install assembly in housing, being careful not to damage lever shaft oil seal.

8. Install new side cover gasket (18) to housing then install side cover (14). Side cover is secured to housing with seven bolts, nuts, and lock washers; also, two cap screws and lock washers which should be tightened evenly and alternately until tight.

9. Adjust lever shaft end thrust as directed under "Lever Shaft Thrust Adjustment" under adjustments.

10. Install pitman shaft on lever shaft serrations, being sure that alignment marks on pitman shaft and lever shaft are in alignment. Install flat washer (28) and nut (29) and tighten nut securely. Then install cotter pin.

11. Press caulking compound (26) securely in place around serrations on pitman shaft on upper surface of pitman arm.

STEERING PROPELLER SHAFTS

Steering propeller shafts and center bearing assembly mounting, which transmit motion between steering column bevel gear and steering gear, are illustrated in figure 1. Propeller shafts (fig. 6) are tubular type equipped with needle bearing type universal joints at each end, also a splined slip joint to absorb endwise movement. Center bearing assembly (fig. 7) is supported by a bracket riveted into body understructure.

REPLACEMENT

REMOVAL

Remove nuts and lock washers from the two U-bolts at each end of the shaft, then remove U-bolts. Tap joint assembly with soft hammer to loosen assembly from yoke, then tape loose bearings to trunnion.

INSTALLATION

Position shaft assembly in its correct location with slip joint end toward front of vehicle. NOTE: Before installing observe that two slip joint arrows (fig. 6) are in alignment. With trunnion bearings seating in mating yoke, install U-bolts, nuts, and lock washers. Tighten nuts evenly and alternately until tight.

DISASSEMBLY

1. Remove slip joint dust cap (10) and washer (9), then pull slip joint assembly from shaft.

2. Remove snap rings (1) retaining bearings in yoke. Use soft hammer to drive journal (3) side ways and push one bearing (2) out of yoke. Turn shaft over and drive journal in opposite direction to remove opposite bearing from yoke. NOTE: Rollers will drop out of bearing. Use care to prevent damage or loss of rollers.

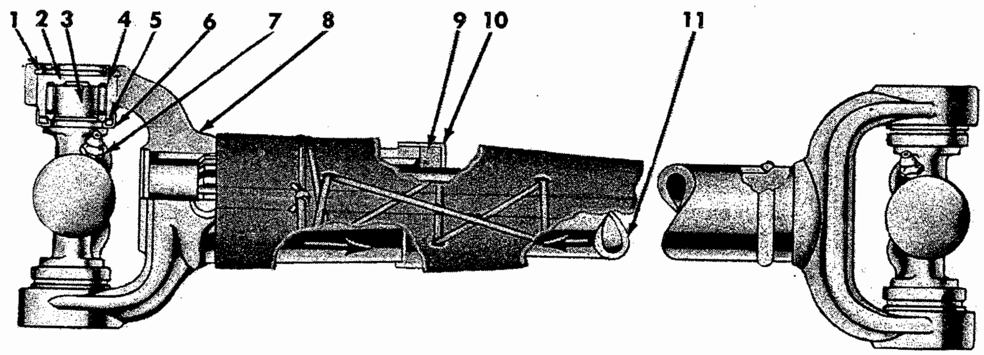
3. Remove journal from yoke, then remove four gaskets (5) and retainers (6) from journal.

CLEANING AND INSPECTION

1. Wash all parts in cleaning fluid to remove all accumulated dirt and old lubricant. Make sure that lubricant passages in journal are clean.

2. Check needle bearings, outer race, and journal for visual wear, or damage. Pack race one-third full of grease to retain rollers, then install on journal to check fit on journal. If excessive clearance is evident, replace bearings, race, or journal as necessary.

3. Always use new gaskets and replace retainers if damaged.



1 Snap Ring
2 Bearing Cap
3 Journal
4 Bearing Roller
5 Gasket
6 Gasket Retainer
7 Lubrication Fitting
8 Yoke
9 Gasket
10 Dust Cap
11 Propeller Shaft

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Figure 6—Steering Propeller Shaft

ASSEMBLY

1. Install four retainers (6) and new gaskets (5) on journal arms.

2. Position journal arms in yoke, then press bearing assembly onto two opposite journal arms. Press bearings enough to permit installation of snap rings (1) into yoke grooves. Tap journal lightly with soft hammer to force bearings outward against snap rings.

3. Install two remaining bearings on journal arms and tape into place until assembly is to be installed.

STEERING PROPELLER SHAFT SUPPORT

Forward and rearward steering propeller shafts are connected and supported by an assembly attached to understructure (fig. 7).

DISASSEMBLY

1. Disconnect rear end of front propeller shaft and forward end of rear propeller shaft as directed previously in this section.

2. Remove yoke retaining screw (7), lock washer (6), and flat washer (5), from either yoke. Use suitable puller to pull yoke (8) and seal assembly (2) from stub shaft.

3. Push stub shaft (9) and opposite yoke assembly out of support and bearing. Mount stub shaft in vise having soft jaw plates and remove yoke screw, and washer, then pull yoke from shaft.

4. Press oil seal assembly (2) from each yoke. Remove two bearing retainers (3) from support, then remove bearing (4).

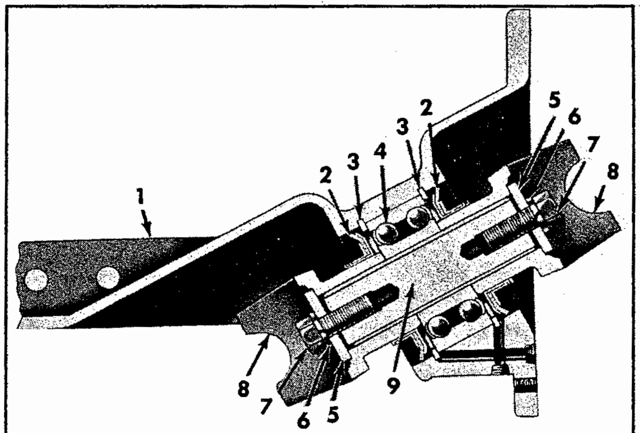
CLEANING AND INSPECTION

Immerse all parts in suitable cleaning fluid to loosen and remove all deposits and accumulations of dirt and old lubricant. Remove lubrication fitting and pipe plug from support, then clean lubricant passages and inside of support.

Inspect bearing to determine its fitness for further use and replace if wear or roughness is evident.

ASSEMBLY

1. Install one bearing retainer (3) into groove in propeller shaft bearing support (1).



1 Support
2 Oil Seal Assembly
3 Bearing Retainer
4 Bearing
5 Flat Washer
6 Lock Washer
7 Retaining Screw
8 Yoke
9 Stub Shaft

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Figure 7—Steering Propeller Shaft Support

2. Install bearing in support, then install opposite bearing retainer. Carefully check both bearing retainers to be sure they are fully seated.

3. Press new oil seal (2) assembly onto each yoke (8) until seal is 1/8" below end of yoke.

4. Install yoke and seal assembly onto stub shaft (9) and secure with flat washer (5), lock washer (6), and cap screw (7).

5. Apply a liberal coating of grease to lip of oil seals. Install stub shaft (9) and yoke assembly into support and bearing, then install opposite yoke and oil seal assembly. Install yoke retaining flat washer, lock washer, and cap screw, then tighten both yoke retaining screws (7).

6. Install lubrication fitting in support and apply lubricant recommended in LUBRICATION (SEC. 13) until it appears at lip of seal, indicating that bearing is thoroughly lubricated.

7. Connect front and rear steering propeller shafts to center support yokes as directed previously in this section.

STEERING DRAG LINK

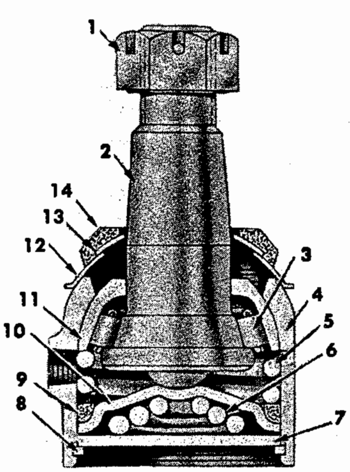
Steering drag link assembly is composed of drag link and end assembly (fig. 8). Drag link end is roller bearing type and incorporates an adjustment feature, which automatically compensates for wear on bearing surfaces. End assembly at pitman arm threads onto drag link to provide for length adjustment. Adjustable end is clamped to tie rod with bolts.

MAINTENANCE

Linkage between steering gear and front axle definitely affects steering action if parts are out of adjustment, bent, or twisted. Check steering geometry and front wheel alignment when steering linkage is repaired or replaced.

Drag link end stud nuts must be kept tight or stud holes in steering arm and Pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs into arms so far that dust cover parts may be damaged during sharp turns.

Drag link ends are equipped with lubrication fittings and should be lubricated as directed in LUBRICATION (SEC. 13).



1 Stud Nut
2 End Stud
3 End Stud Bearing
4 Drag Link End
5 Socket Centering Spring
6 End Stud Seat Spring
7 End Plug
8 End Plug Lock
9 End Stud Seat Grease Retainer
10 End Stud Seat
11 End Stud Bearing Seat
12 Inner Dust Seal Cover
13 Outer Dust Seal
14 Outer Dust Seal Cover

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Figure 8—Steering Drag Link End Assembly

LENGTH ADJUSTMENT

Under ordinary circumstances it should not be necessary to change length of drag link, except when new or reconditioned link is being installed. When necessary to adjust length, proceed as follows:

1. Position front wheels straight ahead.

2. Position steering gear Pitman arm so that the ball stud hole is 3/16" to left of center of Pitman arm shaft (fig. 14).

3. With stationary end of drag link installed turn socket end as necessary to permit installation of ball stud in Pitman arm while arm is 3/16" to left of center of Pitman arm shaft.

4. When correct adjustment has been obtained, and ball studs at each end are in same plane, tighten two drag link end clamp bolts and nuts.

DRAG LINK END OVERHAUL

Normal wear on bearing surfaces in drag link end will result in increased overall height of assembly. If excessive play is noted, drag link ends must be removed and disassembled for replacement of worn parts.

DISASSEMBLY (Fig. 8)

1. Loosen clamp bolt nuts and unscrew drag link end from drag link (at Pitman arm end).

2. Remove outer dust seal cover (14), outer dust seal (13), and inner dust seal cover (12) from end stud (2).

3. Pry end plug lock (8) out of drag link end (4); then remove end plug (7), end stud seat spring (6), end stud seat (10), grease retainer (9), socket centering spring (5), end stud (2), end stud bearing (3), and end stud bearing seat (11) from drag link end

CLEANING AND INSPECTION

1. Immerse all parts except outer dust seal cover (14) in a suitable cleaning fluid. Use a stiff bristle brush as required and clean all parts thoroughly.

2. Check all parts for wear or corrosion and discard parts that are damaged.

3. Check tension of end stud seat spring (6). Discard spring if tension is not within limits given in "Specifications," at end of this section.

4. Carefully inspect rollers in end stud bearing assembly (3) for roughness or flaking. If rollers will not rotate freely in retainer, bearing assembly should be replaced.

ASSEMBLY (Fig. 8)

Keep all parts clean when performing assembly operations. If dirt or grit is allowed to get into drag link end when assembling, premature and excessive parts wear will result.

1. Lubricate all parts with lubricant specified in LUBRICATION (SEC. 13). Place end stud bearing (3) and bearing seat (11) on end stud (2).

2. Insert stud and bearing assembly into drag link end (4); then press grease retainer (9) over end stud seat (10). Place centering spring (5) and stud seat (10) in drag link end; then install end stud seat spring (6) and end plug (7). Secure parts in drag link end (4) with end plug lock (8).

3. Install inner dust seal cover (12), outer dust seal (13), and outer dust seal cover (14) on threaded end of stud.

4. Install drag link end assembly on drag link, but do not tighten clamp bolt nuts. Clamp bolts must be installed with nuts on end stud side.

5. Adjust drag link length as previously directed under "Length Adjustment"; then lubricate, as directed in LUBRICATION (SEC. 13).

Power Steering

A power steering system, available as special equipment, is adaptable to the standard mechanical steering system with a minimum number of changes. Figure 9 illustrates power steering booster cylinder installed.

OPERATION

Power steering is accomplished through use of hydraulic pressure from the power steering hydraulic pump which is mounted on flywheel end of engine. Pressure created by pump is circulated through flexible fluid lines to a self-contained actuating booster cylinder installed on front axle. Movement of steering wheel is transmitted through conventional pitman arm and drag link to a control valve located in booster cylinder. This control valve directs hydraulic fluid, under pressure created by pump to either side of a piston in the booster cylinder producing movement of piston

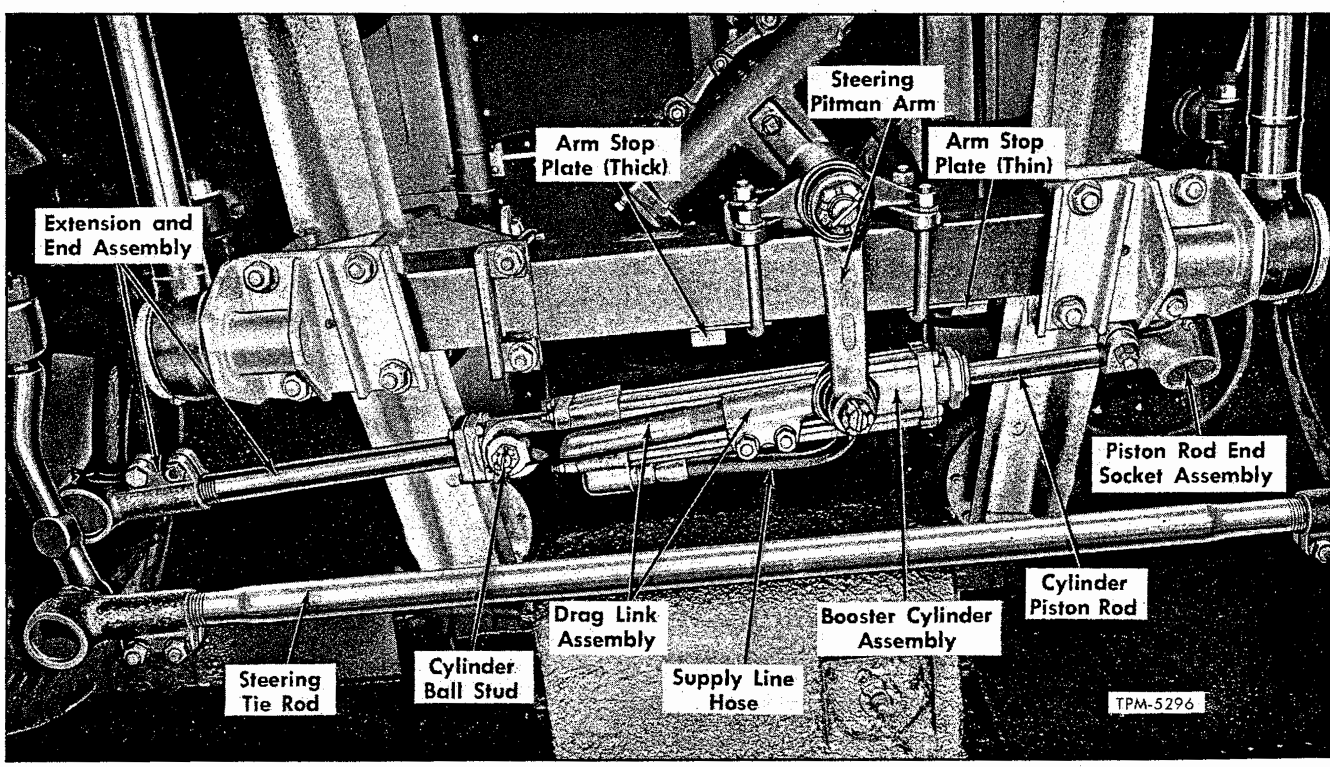


Figure 9—Power Steering Booster Cylinder Installed

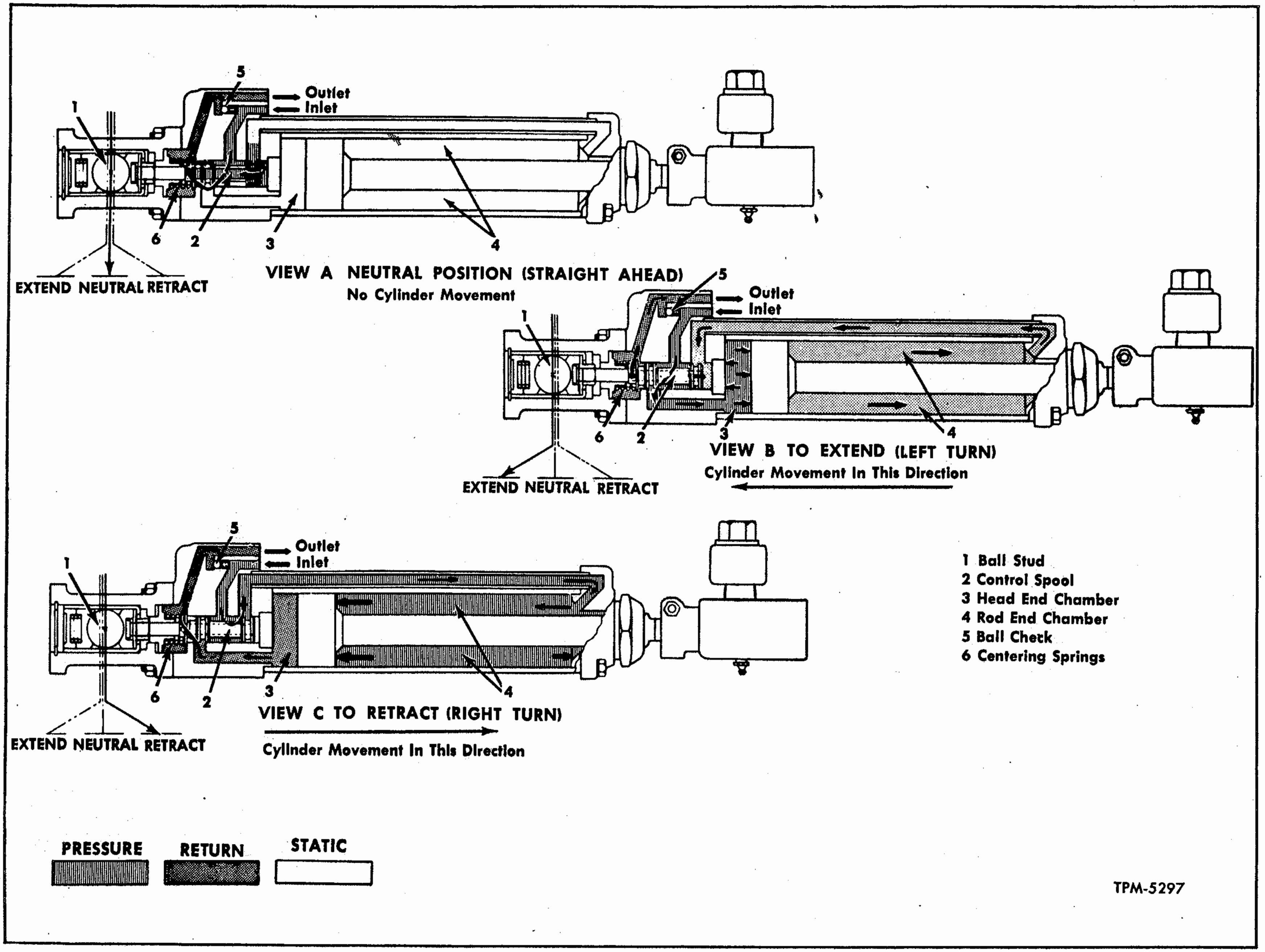


Figure 10—Operational Diagrams of Booster Steering Cylinder (Typical)

and attached drag link of coach steering linkage. Force applied by booster cylinder to drag link is automatically the amount of thrust necessary for all steering requirements.

Figure 10 illustrates schematic views of booster operations: View "A," illustrates neutral position; View "B" - left turn position, (cylinder extended), and View C - right turn position, (cylinder retracted).

Key numbers in following text refer to figure 10.

Movement of steering wheel in either direction is transmitted to the mechanical linked ball stud (1) which in turn imparts linear movement of control spool (2). Oil flow from pump is directed by spool movement either to the head end or rod end chambers (3 or 4) of the cylinder as shown in Views "B" and "C," causing the booster to extend or retract. This action causes a corresponding movement of the booster which will continue so long as the control spool is offset by continued turning of the steering wheel. As soon as the turning of the steering wheel is stopped the booster will again come to center (neutral) position, View "A" and stop. In the event of power failure, ball check (5) will unseat, allowing free flow of oil throughout the booster. This will allow the steering mechanism to be moved manually, either by the steering wheel or by external force applied to the vehicles wheels.

Strong centering springs (6) on the control spool (2) provide the driver the desired steering "feel."

MAINTENANCE

The hydraulic system must be kept clean to insure maximum operating performance and trouble free service. Periodic inspection, and renewal of the hydraulic oil is recommended. When the slightest evidence of dirt, sludge, and water is discovered in the system, drain and refill with clean recommended hydraulic fluid. Refer to LUBRICATION (SEC. 13) for fluid type. To drain system, disconnect fluid lines at booster cylinder.

Power steering fluid filter located in fluid line at engine bulkhead should be serviced at regular lubrication intervals. Refer to "Power Steering Fluid Filter" later in this section for servicing filter.

Air in the fluid system will cause spongy action and noisy operation. Bleed system as instructed later under "Bleeding Power Steering Hydraulic System."

If steering linkage between steering gear and front axle is out of adjustment, bent, twisted, or worn, steering action of coach will be seriously affected. At any time steering linkage parts are repaired, replaced, or adjusted, steering geometry and front wheel alignment must be checked. Refer to "FRONT AXLE" (SEC. 1) for front end alignment information.

At regular lubrication intervals, the steering linkage should be checked completely for worn or loose ball stud sockets.

If coach steering tends to wander in one direction after making certain that front end is properly aligned, the control valve in booster cylinder may not be centering properly. Adjust control valve as explained later under "Control Valve Adjustment."

BLEEDING POWER STEERING HYDRAULIC SYSTEM

When power steering pump, booster cylinder assembly, or fluid filter has been removed for overhaul or replacement, or any hydraulic system lines disconnected, the hydraulic system must be bled before vehicle is again operated. Bleed power steering hydraulic system as follows:

NOTE: When hydraulic fluid is added to power steering system, fluid should be poured through a 200 mesh wire screen secured inside funnel. Use only the hydraulic fluid recommended in LUBRICATION (SEC. 13) of this manual in the power steering hydraulic system.

1. Fill power steering pump reservoir tank to "FULL" mark on dipstick. Let hydraulic fluid remain undisturbed for about two or three minutes.
2. Raise front end of coach until front wheels are well off floor.
3. Eliminate air pockets in booster cylinder and hydraulic system by turning front wheels to right and left pitman arm stops. Continue this procedure, while maintaining fluid level in pump reservoir tank to "FULL" mark on dipstick until fluid in pump tank stops bubbling.
4. Start engine and run at idle for two or three minutes. Turn front wheels to right and left as before. Do not hit wheel stops. Maintain fluid level in pump reservoir tank to "FULL" mark on dipstick. Check system lines and connections for leaks. Continue these procedures until fluid in pump reservoir tank is clear and free of bubbles.
5. Increase engine speed to approximately half throttle and run engines at this speed until all signs of air bubbles cease to exist in pump reservoir tank. Turn wheels to right and left as before. Do not hit pitman arm stops.
6. Lower coach to floor and turn wheels to right and left while rechecking for fluid leaks.
7. Recheck fluid level in pump reservoir tank and fill to "FULL" mark on dipstick.

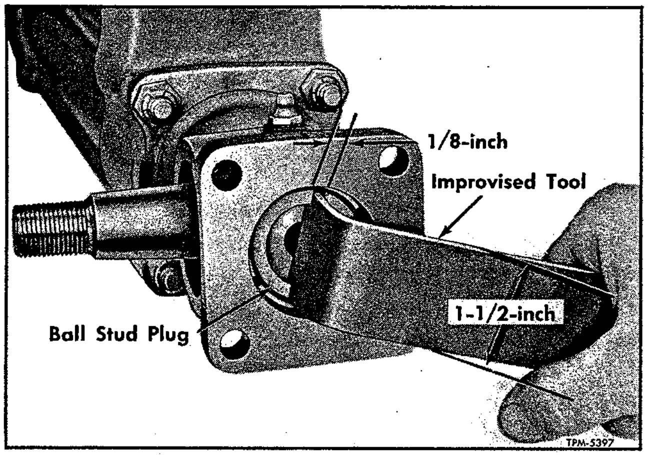


Figure 11—Removing Ball Stud Plug Using Improvised Tool

BOOSTER CYLINDER CONTROL VALVE ADJUSTMENT

Steering booster cylinder is equipped with an adjustable control valve. At time of manufacture this valve is adjusted to provide straight ahead control, thus any tendency to wander to right or left can be corrected. Whenever the booster cylinder has been overhauled, or vehicle wanders to right or left, the following adjustment should be made.

In some instances operators may perform this adjustment at a bench, using an auxiliary source for hydraulic pressure. When adjustment must be made on the vehicle the following instructions apply.

1. Disconnect booster cylinder assembly from adjustable extension by removing four attaching nuts and bolts.

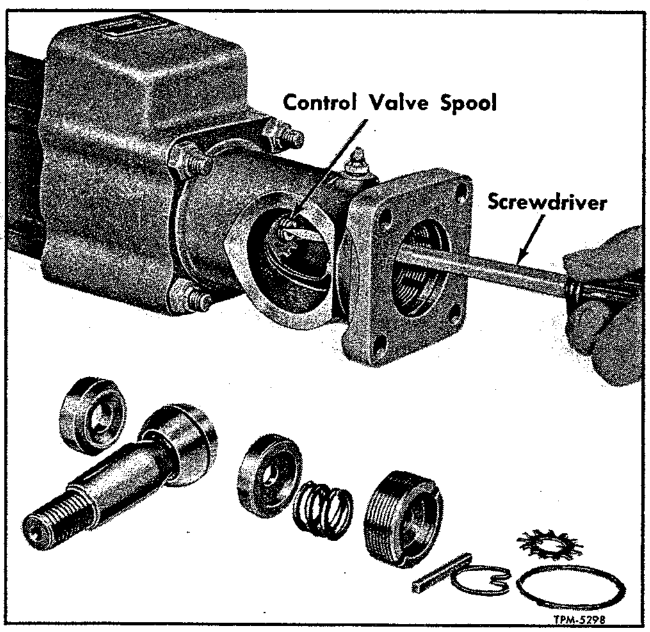


Figure 12—Booster Cylinder Control Valve Spool Adjustment

2. At piston rod end socket ball stud, remove cotter pin and nut. Remove ball stud from suspension support integral bracket.
3. At booster cylinder body, remove snap ring, lock key, end plug and spring. NOTE: Use improvised tool shown in figure 11 to remove end plug. Remove ball stud and two ball stud seats. Remove centering nut locking washer from centering nut. Straighten tab on locking washer if washer is to be reused.
4. Suspend booster cylinder assembly in a horizontal position so that piston rod can extend or retract without interference.
5. Start engine and operate at fast idle (approximately 600 to 700 rpm) to operate power steering hydraulic pump. Insert a screwdriver in position in slot of spool as shown in figure 12. Hold the centering nut firmly in position, and adjust the spool until the rod is in 1/2 extended position. To do this turn the spool clockwise to retract or counterclockwise to extend the rod. The spool is centered when the rod does not creep in either direction.
6. Lock valve spool in place by installing centering nut locking washer. Insert inside diameter tabs of the locking washer in the slot of the spool. One of the outside diameter tabs should then line up with one of the centering nut slots. Bend tab of washer into slot of centering nut (fig. 13). Use punch and hammer.
7. Install ball stud seat, ball stud, and second ball seat in body. Install ball stud seat spring, then thread end plug into body to secure ball stud and seats. Thread plug against the spring solidly, then back off to first key slot in ball stud sleeve. Install lock key and snap ring.
8. Recheck for piston rod creeping (Step 5 above), there must be no movement of rod. Repeat

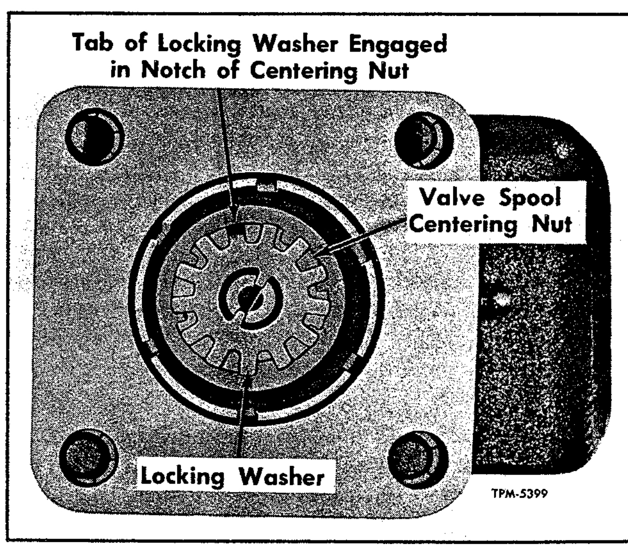


Figure 13—Valve Spool Locking Washer Installed

adjustment if necessary.

9. Complete installation of booster cylinder to coach. Lubricate cylinder ball stud as directed in LUBRICATION (SEC. 13).

BOOSTER CYLINDER REPLACEMENT

Power steering booster cylinder assembly installed as shown in figure 9, can be readily removed from coach at any time service is required that necessitates disassembly or partial disassembly of unit. Remove booster cylinder assembly from coach as described in the following: When reinstalling booster cylinder assembly be sure to accomplish adjustment procedures as outlined.

REMOVAL

1. Attach identification tags to flexible inlet and outlet lines; then remove lines and allow lines and cylinder to drain.

2. Remove cotter pin and stud nut attaching adjustable steering drag link to booster cylinder ball stud. Discard cotter pin.

3. Remove cotter pin and stud nut attaching piston rod end socket tapered stud to suspension support bracket: Discard cotter pin.

4. Remove four lock nuts and bolts attaching flange of booster cylinder ball stud body to flange of end socket extension.

5. Remove booster cylinder assembly from drag link end and suspension support bracket. It may be necessary to use a suitable puller to aid in removal.

6. Remove dust cover spring and dust cover from booster cylinder ball stud, and dust cover spring, shield, dust cover, and washer from piston rod end socket tapered stud to prevent loss of parts.

7. Remove set screw and clamp bolt; then turn piston rod end socket off piston rod.

INSTALLATION (Refer to Figs. 9 and 14)

1. Compress booster cylinder assembly into fully retracted position; then thread piston rod end socket assembly on booster cylinder piston rod to a dimension of 26-25/32", measured from centerline of socket end tapered stud to centerline of booster cylinder ball stud.

2. Position dust cover and dust cover spring on booster cylinder ball stud, and washer, dust cover, shield, and dust cover spring on piston rod end socket tapered stud.

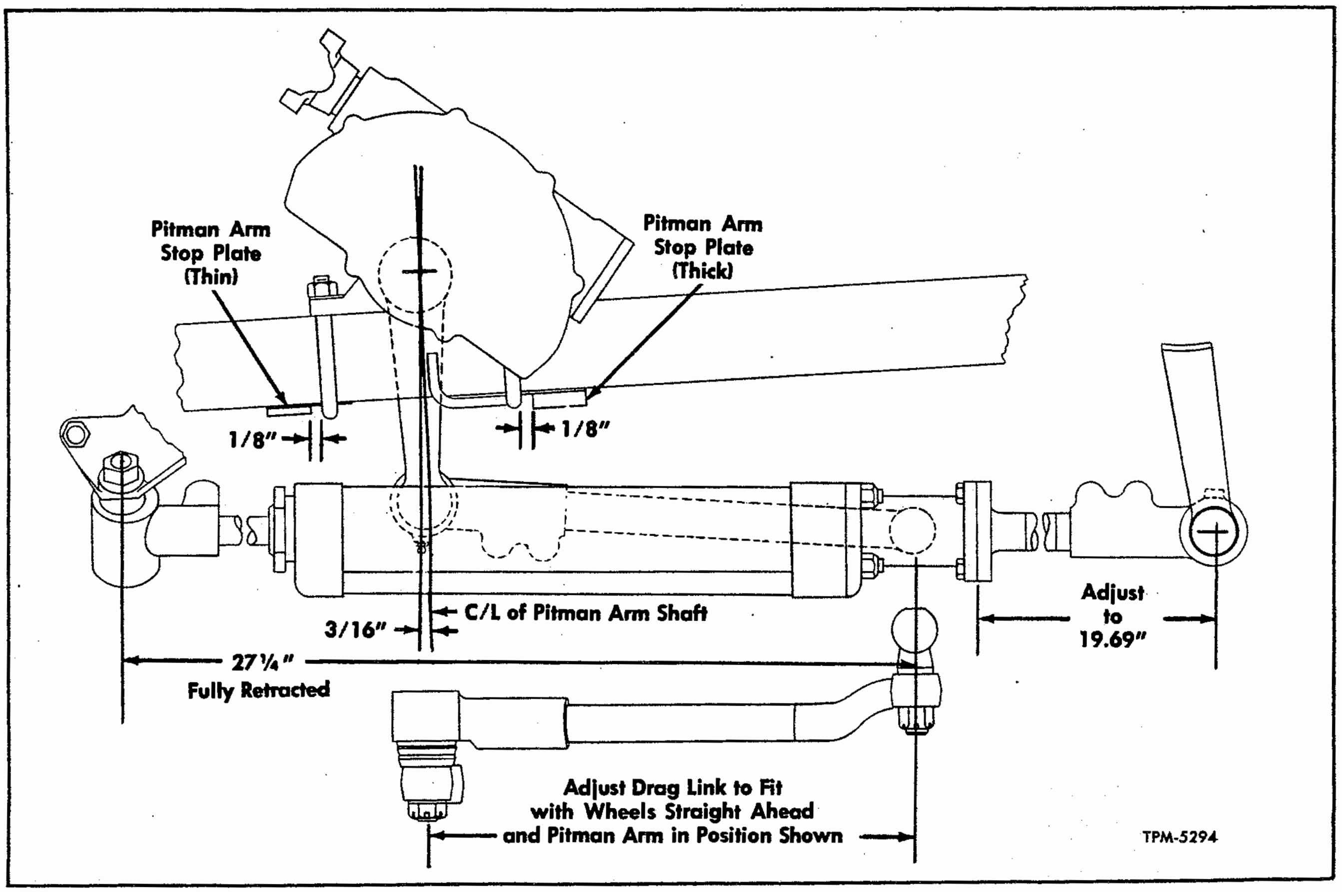


Figure 14—Power Steering Booster Cylinder Installation

3. Check length of cylinder extension and end assembly, measuring from center of end socket ball stud to flange of extension (fig. 14). Distance should measure 19.69". Adjust if necessary.

4. At this stage of installation the booster cylinder could be suspended horizontally under coach and fluid lines connected to unit, then the control valve could be adjusted for centering. See "Booster Cylinder Control Valve Adjustment" explained previously. Start with Step 3.

5. Position booster cylinder ball stud body flange to flange of end socket extension, at the same time inserting booster cylinder ball stud in hole at end of drag link and piston rod end socket tapered stud into hole in suspension support bracket. NOTE: Cylinder ball stud to drag link must be positioned at bottom of cylinder.

6. Dip threads of extension bolts in Lubriplate #110; then attach booster cylinder ball stud body flange to flange of end socket extension with four bolts and lock nuts. Tighten bolts to 35-40 foot-pounds torque.

7. With booster cylinder ball stud inserted through hole at end of drag link, install stud nut on ball stud. Tighten stud nut to 100 foot-pounds torque; then install new cotter pin to secure nut.

8. With piston rod end socket tapered stud inserted through hole in suspension support bracket, install stud nut on tapered stud. Tighten nut to 150 foot-pounds torque; then install new cotter pin to retain nut.

IMPORTANT: It is important that the following adjustments be checked.

9. Check position of pitman arm on steering gear lever shaft as described previously under "Steering Gear Replacement." Front wheels must be positioned straight ahead. If steering gear Pitman arm is correctly positioned on shaft, centerline of hole at drag link end of arm is 3/16-inch further from centerline of coach than centerline of hole at opposite end of arm is (fig. 14). If pitman arm is incorrectly positioned on lever shaft, remove arm from shaft and reposition as previously directed.

10. Check adjustment and position of booster cylinder extension and socket end assembly. If socket end assembly and booster cylinder are installed and adjusted correctly, flange of extension and flange of booster cylinder ball stud body will be tipped heel down 3° or almost level. (See figure 9.)

11. Check position and adjustment of steering drag link assembly as described under "Drag Link Adjustment" following in this section. If steering drag link assembly is correctly installed and adjusted, booster cylinder ball stud flange will be parallel with eye surface of drag link. End socket tapered stud will center in hole of pitman arm and booster cylinder ball stud will center in hole at eye end of drag link. If steering drag link assembly is incorrectly installed and adjusted, remove steering drag link assembly from coach and reposition and adjust as described.

12. With all parts correctly positioned and adjusted, and all bolts and nuts properly torqued, connect inlet and outlet flexible lines to fittings of booster cylinder. Tighten set screw firmly in piston rod end socket at suspension bracket. Stake screw in three places.

13. Refill power steering hydraulic system; then bleed system as directed previously under "Bleeding Power Steering Hydraulic System."

BOOSTER CYLINDER REPAIR

BOOSTER CYLINDER DISASSEMBLY

NOTE: Key numbers in text refer to figure 15.

NOTE: If ball stud body (66), valve body (33), cylinder tube (40), and cylinder cap (44) have not been scribed with alignment marks, use prick punch and mark these parts so they can be reassembled in same relative position.

1. Remove socket clamp bolt nut (18) and bolt (9); then remove set screw (17) from piston rod end socket (16).

2. While holding piston rod (41) with 1" open end wrench, turn piston rod end socket (16) off piston rod (41).

NOTE: Overhaul piston rod end socket assembly as described later under "Booster Cylinder Extension and End Socket" which will apply.

3. Remove four stud nuts (19); then remove four thru studs (20) attaching cylinder tube and cap assembly to ball stud body assembly.

4. Using plastic hammer, tap valve body assembly off cylinder tube and cap assembly.

5. Remove oil passage tube (39) from bore in cylinder cap (44); then remove oil passage tube spring (43) from bore in cap.

6. Cut lock wire (8) from hole in piston rod packing nut (46); then turn packing nut off threads of cylinder cap.

7. Pull piston rod assembly out of cylinder tube and cap.

8. Remove one piston rod packing outer adapter (49), five piston rod chevron packing (50), and one piston rod packing inner adapter (51) from cylinder cap. Discard packings.

9. Remove piston rod wiper seal (47) from piston rod packing nut (46). Discard wiper seal.

10. Separate cylinder tube (40) from cylinder cap (44). It may be necessary to tap on cap lightly with plastic hammer to separate units.

11. Remove cylinder cap O-ring seal (52)

from cylinder cap (44). Discard seal.

12. Remove oil passage tube O-ring seal (42) from bore in cylinder cap (44). Discard seal.

13. Remove piston rod bushing (45) from bore in cylinder cap (44), only if inspection indicates necessity for removal.

14. Using fingers to spread ring, remove piston ring (54) from groove in piston (53). Do not spread ring more than necessary when removing from piston.

15. Pull piston rod nut cotter pin (56); then remove piston rod nut (55), and piston (53) from piston rod (41).

16. Remove oil passage tube O-ring seal (34) and valve body O-ring seal (57) from valve body (33). Discard both seals.

17. Using snap ring pliers, remove valve body plug snap ring (38) and valve body plug (36) from bore in valve body (33); then remove O-ring seal (37) from groove in plug. Discard seal. NOTE: It may be necessary to tap plug out of valve body with brass drift and hammer.

18. Using snap ring pliers, remove check valve ball spring snap ring (7); then remove washer (6), check valve ball spring (5), and check valve ball (4) from bore in valve body (33).

19. Remove valve body pipe plugs (58) from bores in valve body (33).

20. Remove valve outer centering spring (63) and valve body O-ring seal (60) from ball stud body (66). Discard seal.

21. Remove ball stud nut (1), dust cover spring (2), and pitman rod dust cover (3) from ball stud (25). NOTE: If booster cylinder assembly was removed from coach just prior to disassembly procedures, these parts have been removed.

22. Using snap ring pliers, remove snap ring (22) and snap ring (68) from bore in ball stud body (66).

23. Remove lock key (69) from slots of ball stud plug (67) and ball stud sleeve (27).

24. Remove ball stud plug (67), ball stud spring (23), ball stud seat (24), ball stud (25), and ball stud seat (26) from ball stud body (66).

25. Remove locking washer (65) from end of spool stem then turn centering nut (64) from stem by working screwdriver against lugs of nut. Remove flat washer (28) from spool stem.

26. Remove ball stud sleeve (27) from ball stud body (66).

27. Press valve spool (35) with attached springs, seals and retainer as an assembly from ball stud body.

28. Remove valve centering spring retainer (30), valve middle centering spring (62), inner valve centering spring (61), and valve centering spring washer (59) from stem of valve spool (35).

29. Remove valve centering spring retainer O-ring seal (29) from groove of valve centering spring retainer (30). Discard seal.

30. Remove valve spool O-ring seal (32) and back-up washers (31) from groove in valve spool (35). Discard seal and back-up washers.

31. Remove ball stud lubrication fitting (21) from bore in ball stud body (66).

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 15.

1. Wash all parts thoroughly in cleaning solvent, making sure all accumulations of dirt, grease, or other foreign material is removed. Wipe parts dry with clean lint-free cloth, or blow parts dry with compressed air.

2. Inspect all oil passages in valve body (33) valve spool (35), and cylinder cap (44) to make sure they are clean. A piece of tag wire should be used to check for obstructions.

3. Inspect piston rod bushing (45) in cylinder cap for scoring or excessive wear. If bushing is damaged remove from cylinder cap. Discard bushing.

4. Check cylinder tube (40) and oil passage tube (39) for dents or damage. Make sure inside of tubes are clean.

5. Examine all finished surfaces for nicks, scores, or pitting. Small nicks may be removed with crocus cloth. Replace all parts found to be damaged.

6. Inspect oil seal and ring grooves in valve spool (35), spring retainer (30), valve body (33), valve body plug (36), cylinder cap (44) and piston (53) making sure they are clean and not damaged.

7. Check all booster cylinder springs for free length, compressed length, distortion, or collapsed coils.

8. Check piston ring (54) for excessive wear or damage.

9. Check thru studs (20) for distortion and threads on studs for stripped or crossed condition.

10. Inspect all threaded components of cylinder for stripped or crossed condition.

BOOSTER CYLINDER ASSEMBLY

NOTE: Key numbers in text refer to figure 15.

The following assembly procedures are arranged in a practical sequence for assembling power steering booster cylinder. It is assumed that all parts have been cleaned, and inspected, or replaced as deemed necessary and previously described.

When assembling booster cylinder use new seals, packings, cotter pins, and lock wire. Lubricate each moving part with clean hydraulic fluid before part is installed. When installing new O-ring seals, make sure seals are properly seated in their respective grooves to prevent pressure loss and air intake into hydraulic system.

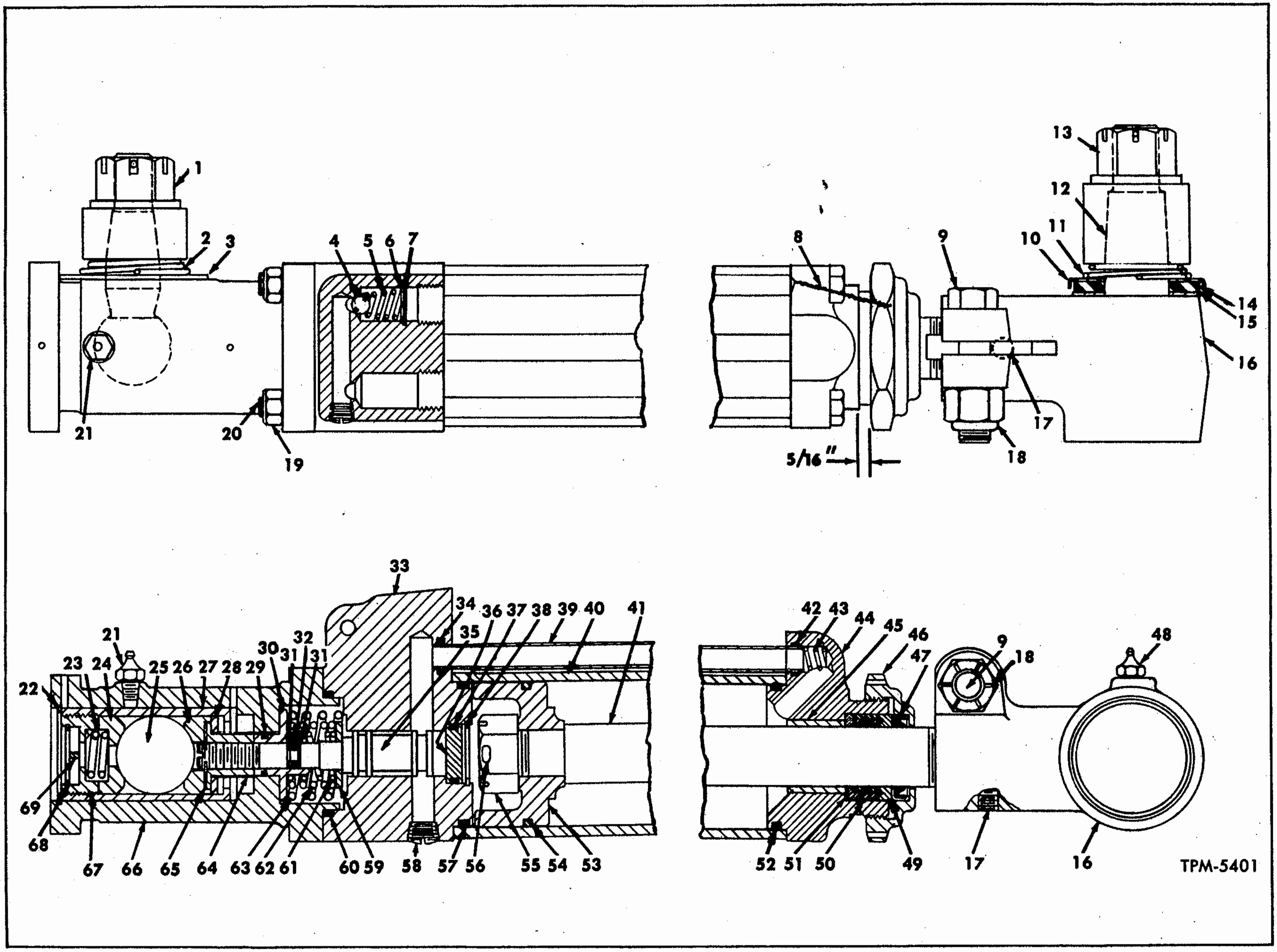


Figure 15—Power Steering Booster Cylinder Assembly

1 Stud Nut	19 Thru Stud Nut	37 O-ring Seal	54 Piston Ring
2 Dust Cover Spring	20 Thru Stud	38 Snap Ring	55 Piston Rod Nut
3 Dust Cover	21 Lubrication Fitting	39 Oil Passage Tube	56 Cotter Pin
4 Check Valve Ball	22 Snap Ring	40 Cylinder Tube	57 O-ring Seal
5 Check Valve Ball Spring	23 Ball Stud Spring	41 Piston Rod	58 Plug
6 Ball Spring Washer	24 Ball Stud Seat	42 O-ring Seal	59 Centering Spring Washer
7 Snap Ring	25 Ball Stud	43 Tube Spring	60 O-ring Seal
8 Lock Wire	26 Ball Stud Seat	44 Cylinder Cap	61 Inner Centering Spring
9 Clamp Bolt	27 Ball Stud Sleeve	45 Piston Rod Bushing	62 Middle Centering Spring
10 Dust Cover Shield	28 Flat Washer	46 Packing Nut	63 Outer Centering Spring
11 Dust Cover Spring	29 O-ring Seal	47 Wiper Seal Assy.	64 Valve Centering Nut
12 Tapered Stud	30 Centering Spring Retainer	48 Lubrication Fitting	65 Centering Nut Locking Washer
13 Stud Nut	31 Back-up Washer (leather)	49 Packing Outer Adapter	66 Ball Stud Body
14 Dust Cover	32 O-ring Seal	50 Packing	67 Ball Stud Plug
15 Dust Cover Washer	33 Valve Body	51 Packing Inner Adapter	68 Snap Ring
16 Piston Rod End Socket Assy.	34 O-ring Seal	52 O-ring Seal	69 Lock Key
17 Set Screw	35 Valve Spool	53 Piston	
18 Lock Nut	36 Valve Body Plug		

Captions For Figure 15—Opposite Page

1. Install ball stud lubrication fitting (21) (if removed) in bore of ball stud body (66). Tighten fitting securely.

2. Install new valve spool O-ring seal (32) and back-up washers (31) with rough side against O-ring seal in groove in valve spool stem (35). Use a sleeve or cover with stiff paper to avoid cutting O-ring seal in assembly. Make sure O-ring seal and back-up washers are properly seated in groove.

3. Install new valve centering spring retainer O-ring seal (29) in groove of spring retainer (30). Make sure seal is properly seated in groove.

4. Position valve centering spring washer (59), valve inner centering spring (61), valve middle centering spring (62), and valve centering spring retainer (30) over stem of valve spool (35).

5. Position valve spool assembly with springs in bore of ball stud body (66).

6. Insert ball stud sleeve (27) into ball stud body (66) and over spool stem.

7. Install flat washer (28) over spool stem, then thread spool centering nut (64) on spool stem (approx. 17 turns - leaving 3 full threads showing).

8. Position new valve body O-ring seal (60) and valve outer centering spring (63) over valve spool (35) and against ball stud body (66).

9. Install valve body pipe plugs (58) in bores of valve body (33). Tighten plugs securely.

10. Insert check valve ball (4), ball spring (5), and washer (6) in bore of valve body (33); then using snap ring pliers, install snap ring (7) to secure parts in place.

11. Install new O-ring seal (37) in groove of valve body plug (36), making sure seal is well seated in groove; then install plug with seal in bore of valve body (33).

12. Using snap ring pliers, install valve body plug snap ring (38) in groove of valve body (33).

13. Insert new valve body O-ring seal (57) and new oil passage tube O-ring seal (34) into grooves in valve body (33). Make sure both of these seals are well seated in their respective grooves.

14. Position piston (53) on piston rod (41), then install piston rod nut (55) on piston rod (41). Tighten nut firmly. Secure nut on piston rod with new cotter pin (56).

15. Using snap ring pliers to expand ring, install piston ring (54) in groove of piston (53). Do not expand ring more than enough to make the installation.

16. If piston rod bushing (45) was removed from cylinder cap (44) during inspection procedures, press new bushing into position in cylinder cap.

17. Position cylinder tube (40) in vise having soft jaw plates; then while carefully compressing piston oil ring (54) with fingers, install piston and rod assembly into cylinder tube (40).

18. Insert new oil passage tube O-ring seal

(42) into bore in cylinder cap. Make sure seal is properly seated in groove.

19. Install new cylinder cap O-ring seal (52) into groove of cylinder cap (44) making sure seal ring is well seated into groove.

20. Position cylinder cap (44) over piston rod (41) and against cylinder tube (40), aligning alignment marks on cylinder cap with marks on cylinder tube.

21. Press new piston rod wiper seal (47) in piston rod packing nut (46). NOTE: Install seal with seal lip position as shown in figure 15.

22. Position one new piston rod packing inner adapter (51), five piston rod chevron packing (50), and one piston rod packing outer adapter (49) over end of piston rod (41) and into cylinder cap (44).

IMPORTANT: Adapters and packing must be positioned as shown in figure 15.

23. Place piston rod packing nut (46) over end of piston rod and on cylinder cap (44). Tighten packing nut to dimension shown in figure 15. Install new lock wire (8) later. NOTE: Piston rod packing nut (46) should not be tightened excessively as piston rod (41) and piston (53) should slide freely in cylinder tube (40) with hand pressure of approximately 35 lbs. of force.

24. Insert oil passage tube spring (43) in bore of cylinder cap (44).

25. With aligning marks on valve body (33) aligned with marks on cylinder cap (44) and cylinder tube (40), move valve body against cylinder tube, at the same time inserting oil passage tube (39) into bore of valve body (33) and bore in cylinder cap (44) against oil passage tube spring (43).

26. Place ball stud body (66) and parts against valve body (33), aligning marks on ball stud body with marks on valve body. Make certain aligning marks on ball stud body (66) valve body (33), cylinder tube (40) and cylinder cap (44) are in alignment; then install four thru studs (20) and four stud nuts (19) connecting the assembly. Tighten nuts on studs alternately and evenly until assembly is securely held together. Torque nuts to 20 to 25 ft. lbs.

27. Install new lock wire (8) around one thru stud and through hole in packing nut as shown in figure 15.

28. While holding piston rod (41) with a 1-inch open end wrench, turn piston rod end socket (16) on piston rod (41) and adjust for length as described later under "Booster Cylinder Piston Rod End Socket."

29. At this stage of assembly, cylinder control valve should be adjusted. Suspend cylinder assembly horizontally under coach, then connect fluid lines to unit. Proceed with Step 4 under "Control Valve Adjustment" explained previously to adjust valve and to complete assembly of cylinder. If valve is not to be adjusted at this time, continue assembly procedures below:

30. Install ball stud seat (26), ball stud (25), ball stud seat (24), ball stud spring (23), and ball stud plug (67) in ball stud sleeve (27). Tighten plug (67) against spring solidly, then back off to first key slot in ball stud sleeve.

31. Position ball stud plug lock key (69) through slots in ball stud plug (67) and ball stud sleeve (27), then install snap ring (68) in groove of ball stud plug (67) to hold lock key (69) in place.

32. Using snap ring pliers, install snap ring (22) in groove of ball stud body (66).

33. If steering booster cylinder assembly is not to be installed on coach immediately after overhaul procedures have been completed, install pitman rod dust cover (3), dust cover spring (2), and stud nut (1) on ball stud (25), so these parts will not become lost before ready for use.

BOOSTER CYLINDER EXTENSION AND END SOCKET

Booster cylinder extension assembly is two-piece type, comprised of an extension and an end assembly. Extension is flanged at end which attaches to booster cylinder and threaded at opposite end for attachment of end socket assembly.

End socket stud is held against a tapered cup by a seat and spring. An end plug and snap ring hold these parts in their correct relative position in end socket (fig. 16).

MAINTENANCE

Tapered stud nut must be kept tight as any looseness of stud at steering arm will cause hole in arm to become enlarged and result in premature replacement of parts. Tightening stud nut after wear has occurred will result in damage to dust covers and springs, particularly when turning to extreme right and left.

Normal wear on bearing surfaces in end socket will cause increase in overall height of assembly. If excessive play is noted, it is evident that worn parts, or complete end socket assembly must be replaced.

At intervals indicated apply recommended lubricant as directed in LUBRICATION (SEC. 13).

REMOVAL

1. Remove cotter pins and nut attaching taper-

ed end socket stud to steering arm at right side. Strike steering arm a sharp blow with hammer as downward pressure is applied at end socket to remove stud from arm.

2. Remove four nuts and bolts attaching extension to booster cylinder assembly.

INSTALLATION

1. With two clamp bolts loose, turn end socket onto extension until dimension from center line of tapered stud to face of extension is 19.69" (fig. 14). Do not tighten bolts until installation is complete.

2. Attach extension flange to booster cylinder assembly using four bolts and nuts. Tighten nuts securely.

3. Position flat washer, dust seal, seal retainer, and spring over end socket tapered pin. Attach tapered pin to steering arm with nut and cotter pin. Tighten end socket clamp bolts.

DISASSEMBLY

NOTE: Key numbers in text refer to figure 16.

1. Remove assembly as previously instructed. Loosen two clamp bolts and nuts, then thread end socket assembly off extension. NOTE: If end socket body is not being repaired or replaced there is no need for removal from extension.

2. Remove flat washer (6), cork dust seal (5), seal shield (4), and spring (3) from tapered stud.

3. Remove snap ring (10), end plug (11), seat spring (12), stud seat (9), and grease retainer (8). When these parts are removed, tapered stud (2) and seat (13) can be easily removed from end socket.

CLEANING AND INSPECTION

Immerse all parts in suitable cleaning solution to loosen and remove all accumulated dirt and grease. Use stiff bristle brush and repeat immersions until all parts are clean.

Inspect all parts for evidence of excessive wear or corrosion. Inspect springs for loss of tension and broken coils. Discard seals and grease retainers. Replace defective and excessively worn parts wherever necessary.

ASSEMBLY

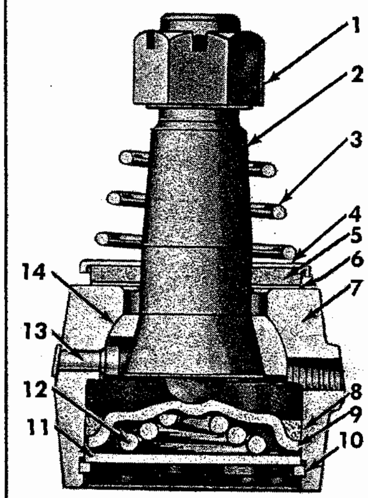
NOTE: Key numbers in text refer to figure 16.

1. During assembly lubricate parts with lubricant recommended in LUBRICATION (SEC. 13).

2. Install seat (14) into end socket with slot over rivet head. Install tapered stud (2).

3. In the order listed install the following parts into end socket: grease retainer (8), stud seat (9), seat spring (12), end plug (11), and snap ring (10).

4. Install lubrication fitting and fill with recommended lubricant.



1 Stud Nut
2 Tapered Stud
3 Spring
4 Shield
5 Dust Seal
6 Flat Washer
7 Socket Body
8 Retainer
9 Stud Seat
10 Snap Ring
11 End Plug
12 Seat Spring
13 Rivet
14 Seat

TP-9236

Figure 16—Booster Cylinder Extension End Socket

BOOSTER CYLINDER PISTON ROD END SOCKET

Power steering booster cylinder piston rod end socket is of the same construction as booster cylinder extension end socket (fig. 16). Piston rod end socket threads directly on piston rod installed in booster cylinder assembly. Refer to "Booster Cylinder Extension End Socket" described earlier in this section for overhaul procedures.

REMOVAL

1. Remove cotter pin and stud nut attaching piston rod end socket stud to suspension support bracket. Using a puller, force socket stud from bracket.

1. Remove set screw, then loosen socket end clamp bolt. Thread socket end assembly off piston rod.

3. Refer to "Booster Cylinder Extension and End Socket" for procedures necessary to overhaul piston rod end socket which are typical.

INSTALLATION

1. Compress booster cylinder assembly into fully retracted position; then thread booster cylinder piston rod end socket on piston rod to a dimension of 26-25/32" measured from centerline of socket end tapered stud to centerline of booster cylinder ball stud.

2. When booster cylinder is correctly adjusted install set screw and clamp bolt. Tighten clamp bolt to 100 ft. lb. torque. Stake set screw in three places.

3. Reinstall piston rod end socket to suspension support bracket. Tighten stud nut to 150 ft. lbs. torque. Secure nut with new cotter pin.

POWER STEERING DRAG LINK

Adjustable steering drag link assembly as used with power steering is composed of two parts, drag link and socket end assembly (fig. 9). Drag link end socket assembly is roller-bearing type incorporating adjustable features which automatically compensate for normal wear. Socket end assembly at pitman arm end of drag link assembly threads on drag link and provides for length adjustment. Socket end assembly is secured to drag link by two clamp bolts. Opposite end of drag link engages booster cylinder ball stud and is secured by a stud nut and cotter pin.

MAINTENANCE

If steering linkage between steering gear and front axle is out of adjustment, bent, twisted, or worn, steering action of coach will be seriously affected. At any time steering linkage parts are repaired, replaced, or adjusted, steering geometry and front wheel alignment must be checked.

Stud nuts at socket end and booster cylinder ball stud end of drag link must be kept tight or hole at ball stud end of drag link and hole in pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs into holes so far that dust cover parts may become damaged and result in premature replacement.

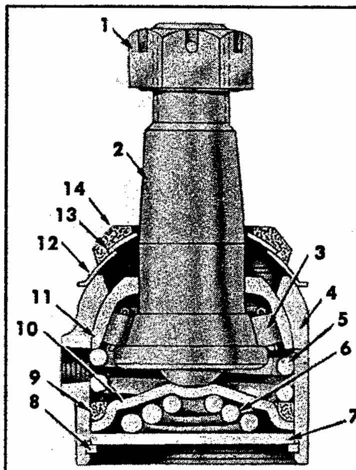
Drag link end is equipped with lubrication fittings and should be lubricated at regular intervals as directed in LUBRICATION (SEC. 13) of this manual.

DRAG LINK ADJUSTMENT

Drag link is adjusted properly when steering wheel is centered-equal number of turns to extreme right or left position, and the front wheels are positioned straight ahead. In this position the center of pitman drag link end should be 3/16" further from center of the coach than the center of steering gear pitman shaft is (see figure 14).

1. If drag link needs adjustment, disconnect drag link at pitman arm. NOTE: Check alignment marks on pitman arm at pitman arm shaft (fig. 5). Marks must be aligned. Realign if necessary.
2. Loosen clamp bolts securing socket end to drag link. With pitman arm positioned to 3/16" dimension stated above (fig. 14) and front wheels straight ahead, turn socket end on drag link as required to align center of end stud with center of eye in pitman arm. Attach socket end to pitman arm. Tighten stud nut to 150 ft. lb. torque, then install new cotter pin.

IMPORTANT: Cylinder end of drag link must be tilted to same plane as flange of cylinder ball stud body before clamp bolts at pitman arm socket end are tightened. Rotate link if necessary, then tighten clamp bolts and nuts firmly to 100 ft. lb. torque.



1 Stud Nut
2 End Stud
3 End Stud Bearing
4 Drag Link End
5 Socket Centering Spring
6 End Stud Seat Spring
7 End Plug
8 End Plug Lock
9 End Stud Seat Grease Retainer
10 End Stud Seat
11 End Stud Bearing Seat
12 Inner Dust Seal Cover
13 Outer Dust Seal
14 Outer Dust Seal Cover

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Figure 17—Power Steering Drag Link Socket

DRAG LINK END SOCKET REPLACEMENT

Refer to "Steering Drag Link Adjustment" for preliminary procedures which will apply for replacement of drag link end socket. In addition to adjustment procedures, remove end socket from drag link.

DRAG LINK END SOCKET OVERHAUL

DISASSEMBLY

NOTE: Key numbers in text refer to figure 17.

1. Remove outer dust seal cover (14), outer dust seal (13) and inner dust seal cover (12), from socket end tapered stud.
2. Position socket end assembly in vise and press end plug (7) in against spring pressure, far enough to remove end plug lock (8) by using screwdriver to pry lock out of groove in socket end (4).
3. Remove end plug (7), end stud seat spring (6), end stud seat (10), grease retainer (9), socket centering spring (5), tapered end stud (2), end stud bearing (3), and end stud bearing seat (11) from drag link socket end (4).

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 17.

1. Clean all parts except outer dust seal cover (14) thoroughly in cleaning solvent. Wipe parts dry.
2. Inspect all parts for corrosion and excessive wear. Discard all parts not in good condition.

3. Check socket centering spring and end stud seat spring (6) for free length, compressed length, distortion, or collapsed coils.

4. Inspect bearing rollers in end stud bearing assembly (3) for roughness or flaking. If rollers will not rotate freely in retainer, replace bearing assembly.

5. Discard dust seal, dust cover, and grease retainer.

ASSEMBLY

NOTE: Key numbers in text refer to figure 17.

When assembling adjustable drag link socket end assembly be sure all parts and working area are thoroughly clean. If dirt or foreign matter is allowed to get into drag link socket end assembly excessive wear and premature replacement of parts will be the result. Lubricate each part with lubricant specified in LUBRICATION (SEC. 13) of this manual as part is installed.

1. Position end stud bearing seat (11) and stud bearing (3) on tapered end stud.

2. Insert stud and bearing assembly into drag link socket end (4).

3. Position socket centering spring (5) in socket end (4) against end stud bearing seat (11).

4. Press new grease retainer (9) over end stud seat (10); then position retainer and seat in socket end (4).

5. Install end stud seat spring (6) and end plug (7) in socket end (4).

6. With socket end assembly positioned in vise, apply pressure against end plug to compress springs; then install end plug lock (8) in groove of socket end (4).

7. Position inner dust seal cover (12), outer dust seal (13), and outer dust seal cover (14) over threaded end of tapered end stud.

8. With drag link socket end assembly cleaned, inspected, and repaired, assemble to drag link and adjust as directed previously under "Drag Link Adjustment."

POWER STEERING HYDRAULIC PUMP

The power steering pump (fig. 18) is a vane type, self contained hydraulic unit which supplies hydraulic power for operation of a steering booster cylinder at front axle. Pump is mounted on gear train cover at rear of engine (fig. 19), and is driven by an accessory drive gear through a coupling (fig. 20).

OPERATION

Hydraulic fluid from pump reservoir enters pump body and is picked up by rotor vanes through inlet ports and pockets, then discharged under pressure through outlet ports in pump pressure plate. Fluid under pressure is also directed through another passage in pressure plate so it enters behind rotor vanes forcing vanes to follow eccentric contour of rotor ring. Remainder of fluid is directed through an orifice in pressure outlet.

Orifice in pressure outlet is calibrated so pump output in excess of 4.0 gallons per minute will cause back pressure. This back pressure opens flow control valve against spring pressure, allowing excess fluid to return to pump reservoir.

If pressure in control valve reaches 950-1000 psi maximum pressure, relief valve will open against spring pressure to limit maximum fluid pressure. When pressure relief valve opens, it allows fluid in pressure outlet passage to pass through flow control valve into pump reservoir.

Fluid flow, as shown in figure 21, is typical of pump operation when coach is driven at low speed during a partial turn. Fluid pressure cannot become high enough to open relief valve because valve spool in control valve is still partially open allowing some fluid to return to pump reservoir. Also, due to low pump speed, fluid pressure is not great enough to open flow control valve.

Figure 22 typically shows operation of steering pump flow control valve and pressure relief valve when coach is driven in full turn at low speed. In this instance, maximum pump pressure is being applied to booster piston to assist in turn and valve spool stops flow of fluid to pump reservoir. High fluid pressure that develops opens both flow control valve and pressure relief valve which limits pressure by allowing fluid to return to pump reservoir.

Figure 23 is typical illustration of operation of flow control valve when coach is driven at high speeds. Pump output exceeds 4.0 gallons per minute, which opens flow control valve allowing fluid to return to pump reservoir. When operating coach at high rate of speeds on straight ahead driving or partial turns, valve spool in control valve is open also allowing fluid to return to pump reservoir. As long as valve spool remains open, pressure buildup will not be sufficient to open pressure relief valve.

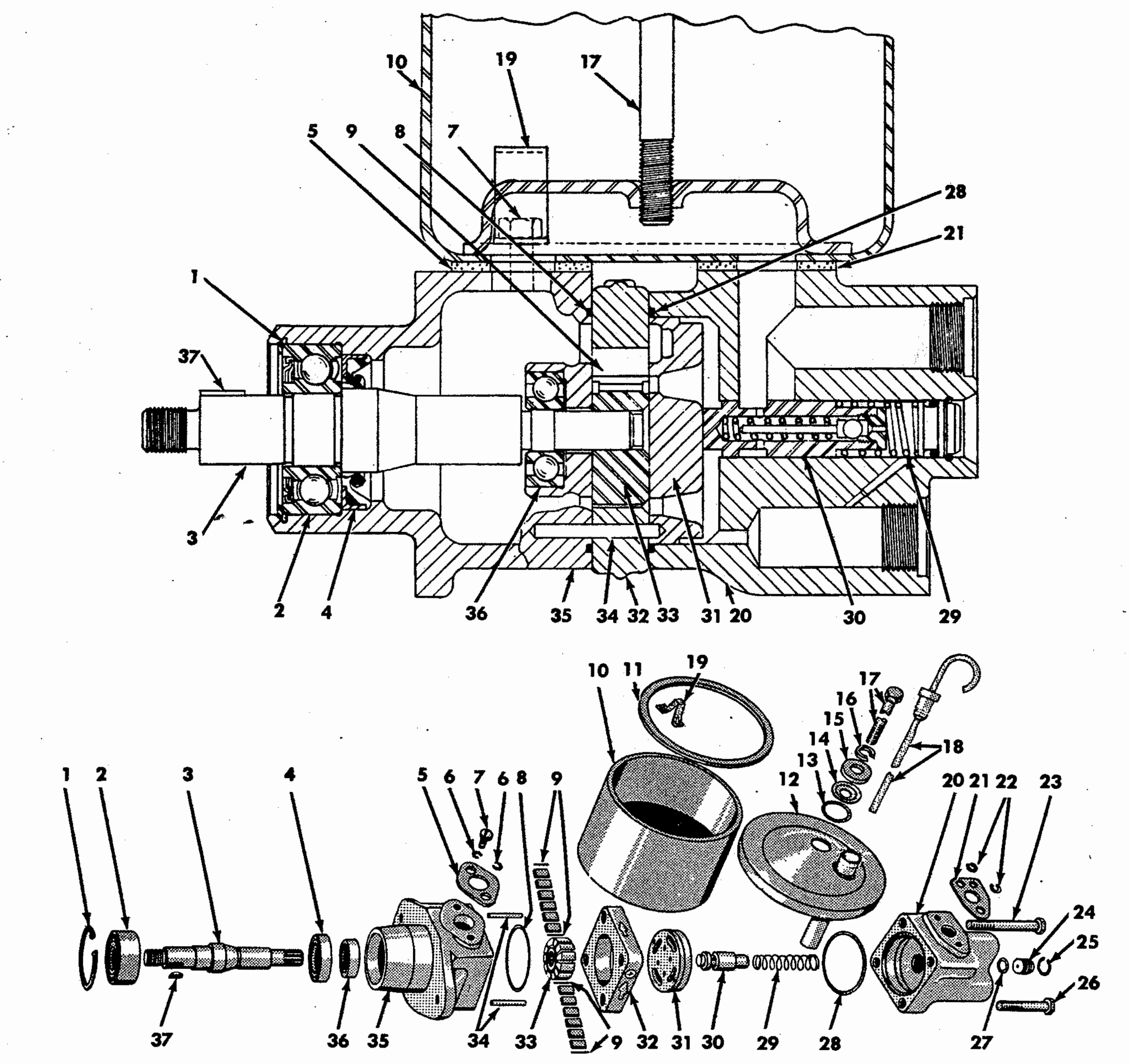
PUMP REPLACEMENT

REMOVAL

NOTE: Key numbers in text refer to figure 20.

1. Remove tachometer access plug and driven gear from power steering pump drive adapter (fig. 19).

2. Place a clean pan under power steering pump inlet and outlet flexible lines to catch fluid;



1 Snap Ring
2 Drive Shaft Outer Bearing
3 Pump Rotor Drive Shaft
4 Oil Seal
5 Gasket
6 Gasket Spacers
7 Mounting Screw
8 Seal Ring
9 Pump Rotor Vanes
10 Reservoir Tank
11 Reservoir Cover Gasket
12 Reservoir Cover
13 Gasket
14 Retainer
15 Washer
16 Lock Washer
17 Reservoir Cover Bolt
18 Dipstick Assembly
19 Oil Baffle
20 Pump Cover
21 Gasket
22 Gasket Spacers
23 Cover to Body Bolt
24 Spring Retainer Plug
25 Snap Ring
26 Cover to Body Bolt
27 Seal Ring
28 Seal Ring
29 Flow Control Valve Spring
30 Flow Control Valve
31 Pressure Plate
32 Pump Body to Cover Ring
33 Pump Rotor
34 Locating Pins
35 Pump Body
36 Drive Shaft Inner Bearing
37 Drive Shaft Key

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Figure 18—Power Steering Pump Components (Typical)

then remove lines from pump by unscrewing fittings.

3. Remove bolts, nuts, and lock washers attaching power steering pump and pump adapter to engine flywheel housing. (fig. 19).

4. Using care to avoid dropping coupling ring (17) and coupling spring (6), remove power steering pump and pump adapter from engine.

5. Remove coupling ring (17) and coupling spring (6); then remove adapter to flywheel housing gasket (16). Discard gasket.

6. Slide power steering driving hub (18) from splines of engine blower drive shaft.

7. Remove two bolts (11) and lock washers (10) attaching power steering pump to adapter (14).

8. Remove nut (3) and plain washer (4) attaching power steering pump driven hub (13) with tachometer drive gear (7) to pump drive shaft.

9. Remove driven hub and adapter from power steering pump; then remove driven hub key (8) and discard adapter to pump gasket (12).

10. If necessary, remove adapter ring (9) from adapter.

INSTALLATION

NOTE: Key numbers in text refer to figure 20.

1. Using Woodruff key (8), install power steering pump driven hub (13) with tachometer drive gear (7) on splines of pump drive shaft.

2. Install nut (3) and plain washer (4) attaching power steering pump driven hub (13) to pump drive shaft. Tighten nut to 55 ft. lbs. torque.

3. Position adapter ring (9) into adapter, then attach adapter and new gasket to power steering pump, using two bolts (11) and lock washers (10).

4. Position coupling spring (6) and coupling ring (17) in pump adapter over driven hub retaining nut.

5. Using Woodruff key (2) position power steering pump driving hub (18) on splines of blower drive shaft.

6. Using new adapter to flywheel housing gasket (16), position power steering pump and adapter assembly on flywheel housing; then attach with bolts, nuts and lock washers (fig. 19). Tighten bolts and nuts securely.

7. Connect power steering pump inlet and outlet flexible lines to pump. Tighten fittings firmly.

8. Refill and bleed power steering hydraulic system as described under "Bleeding Power Steering Hydraulic System" earlier in this section.

PUMP OVERHAUL

Overhaul of power steering pump must be undertaken in clean working area with pump removed from coach engine. It is important that overhaul procedures described in the following text be carefully followed:

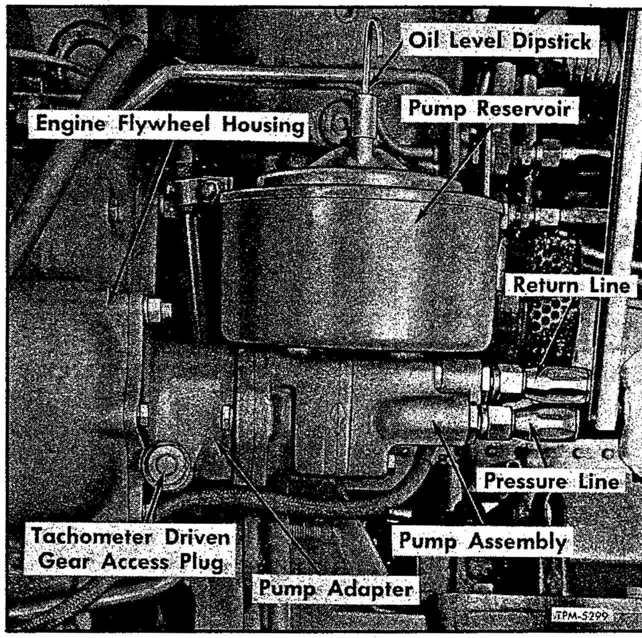
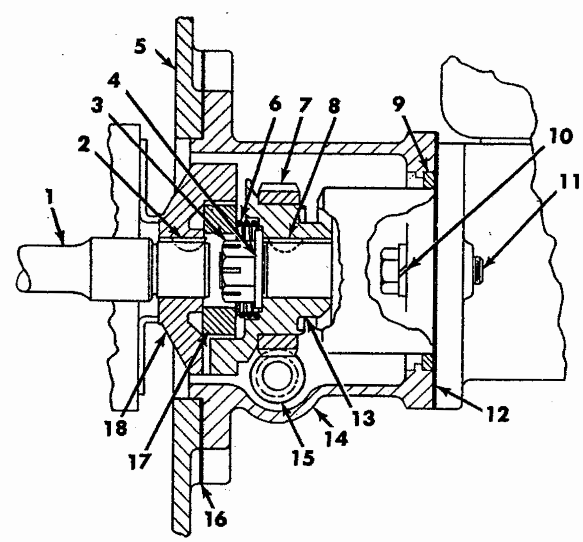


Figure 19—Power Steering Hydraulic Pump Installed



1 Blower Drive Shaft
2 Driving Hub Key
3 Driven Hub to Pump Nut
4 Washer
5 Flywheel Housing
6 Coupling Spring
7 Tachometer Drive Gear
8 Driven Hub Key
9 Adapter Ring
10 Lock Washer
11 Pump to Adapter Bolt
12 Gasket
13 Driven Hub
14 Pump Adapter
15 Tachometer Driven Gear
16 Gasket
17 Coupling Ring
18 Driving Hub TPM-5396

Figure 20—Power Steering Pump Drive

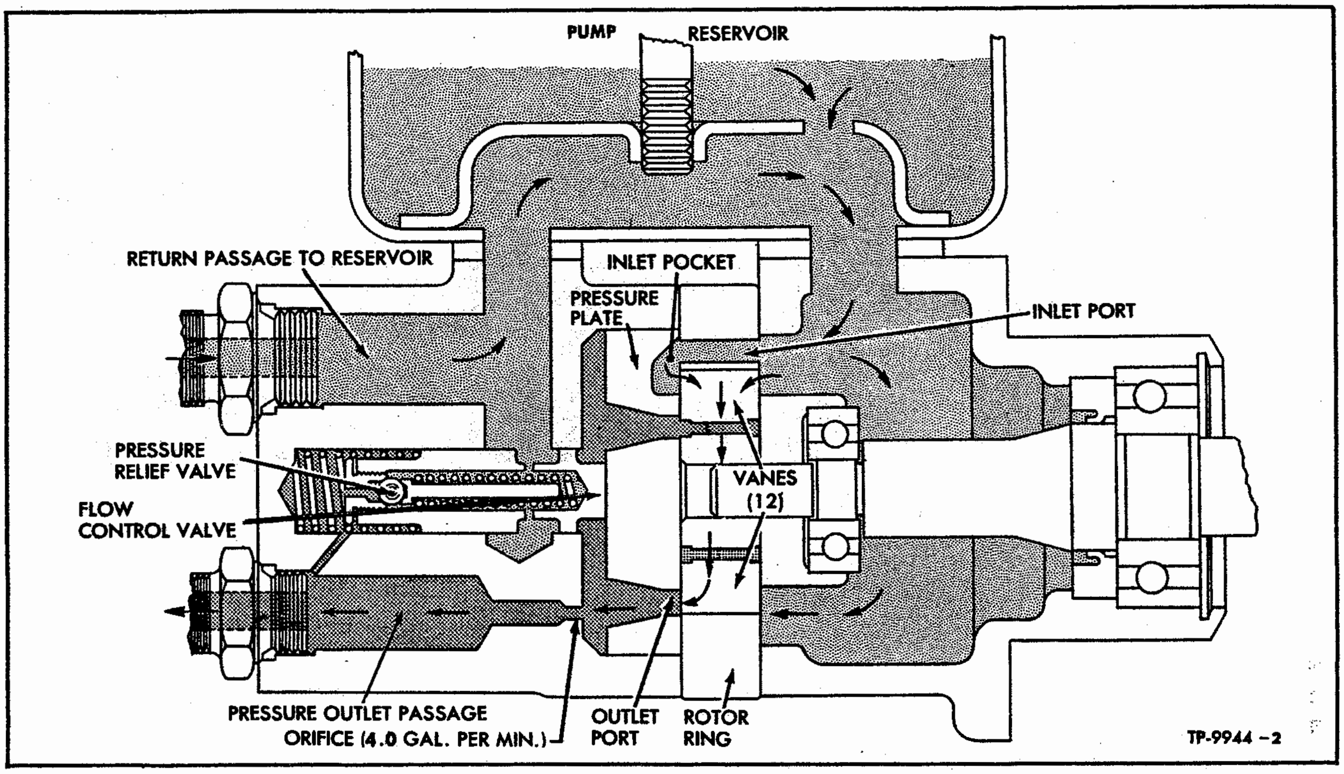


Figure 21—Fluid Flow in Pump with Low Vehicle Speed and Partial Turn (Typical)

DISASSEMBLY

NOTE: Key numbers in text refer to figure 18, unless otherwise specified.

1. Thoroughly clean exterior of power steering pump to prevent dirt from entering pump.
2. Pull dipstick assembly (18) from pump reservoir cover (12).
3. Remove reservoir cover bolt (17); then remove lock washer (16), plain washer (15), retainer (14), and gasket (13).
4. Lift reservoir cover (12) and cover gasket (11) from reservoir tank (10). Discard gasket.

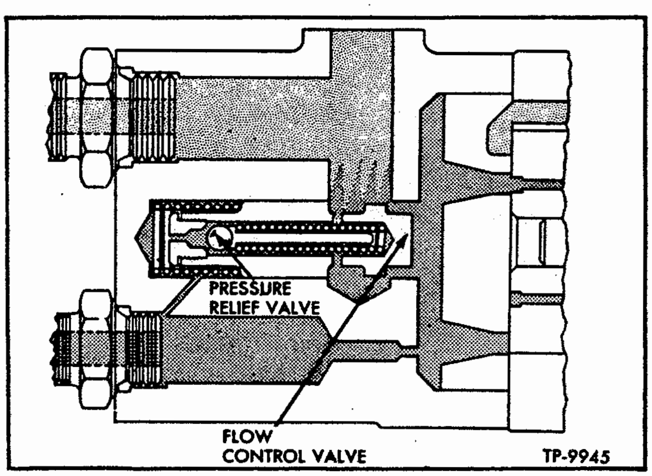


Figure 22—Flow Control Valve and Pressure Relief Valve Operation at Low Speed in Full Turn (Typical)

5. Remove four screws (7) attaching reservoir tank (10) to pump; then remove reservoir tank and oil baffle (19).
6. Remove two gaskets (5 and 21), and four gasket spacers (6 and 22). Discard gaskets and spacers.
7. Remove four bolts (23 and 26) attaching pump cover (20) to pump body (35); then remove pump cover from pump body.
8. Lift flow control valve assembly (30), flow control spring (29), and seal ring (28) from pump cover (20). Discard seal ring (28).
9. If inspection shows necessity for removal remove snap ring (25); then drive spring retainer plug (24) and seal ring (27) from pump cover (20). Discard seal ring.
10. Mark position of pressure plate (31) so it can be reassembled in same relative position; then remove pressure plate from locating pins (34) which extend through pump body to cover ring (32).
11. Mark position of pump body to cover ring (32) so it can be reassembled in same position in relation to pump body (35); then lift ring from locating pins (34).
12. Remove pump rotor (33), rotor vanes (9), and seal ring (8) from pump body (35). Discard seal ring (8).
13. If inspection shows necessity for removal of locating pins (34), remove pins from pump body.

14. Using needle nose pliers, remove snap ring (1) from pump body (35).

15. Pull drive shaft outer bearing (2) and drive shaft (3) from pump body (35). It may be necessary to tap on end of drive shaft with plastic hammer to facilitate removal.

16. If inspection indicates necessity for removal of bearing oil seal (4) and drive shaft inner bearing (36), drive seal out of pump body with punch and hammer; then using care to avoid damage to inner surface of pump body, remove inner bearing from pump body by tapping out lightly with hammer and brass drift.

17. Remove drive shaft key (37) from slot in rotor drive shaft (3).

18. If inspection indicates necessity for replacement of outer bearing (2), press bearing off drive shaft (3) using a 1" I.D. sleeve.

19. If flow control valve assembly (fig. 24) is to be disassembled for inspection or cleaning purposes, maintain pressure on spring loaded plug to prevent loss of poppet relief ball. Be careful not to score ground surfaces of flow control valve.

20. Flexible line union fittings in pump cover should not be removed unless inspection indicates O-ring seals leak or fittings are damaged.

CLEANING AND INSPECTION

NOTE: Key numbers in text refer to figure 18.

1. Clean all parts except drive shaft outer bearing (2) in cleaning solvent. Wipe parts dry with clean lint-free cloth. NOTE: Drive shaft outer bearing (2) is a sealed and shielded roller bearing. Washing bearing in solvent may dilute lubricant sealed into bearing.

2. Rotate bearings slowly by hand, feeling for roughness. Do not mistake dirt or grit in bearing for roughness. Examine bearings for wear or damaged balls. Replace bearings if not in good condition.

3. Check fit of vanes (9) in slots in rotor (33) for tightness or excessively loose condition. Vanes must slide freely but fit snugly in slots in rotor. Tight fit of vanes in rotor may sometimes be corrected by thorough cleaning. Replace rotor if excessive looseness exists between rotor and vanes. Replace vanes if worn or scored.

4. Examine ground surfaces of pump body (35) to cover ring (32) for roughness or excessive wear. Replace ring if condition cannot be corrected with crocus cloth.

5. Inspect ground surfaces of pressure plate (31) and pump body for wear or scores. Slight wear or scoring may be cleaned up by lapping. Lapping compound must be thoroughly washed off parts before they are reinstalled.

6. Inspect ground surfaces of flow control valve (30). Check for freedom of movement of valve in bore of pump cover. Slight wear, nicks, or scores may be corrected with crocus cloth.

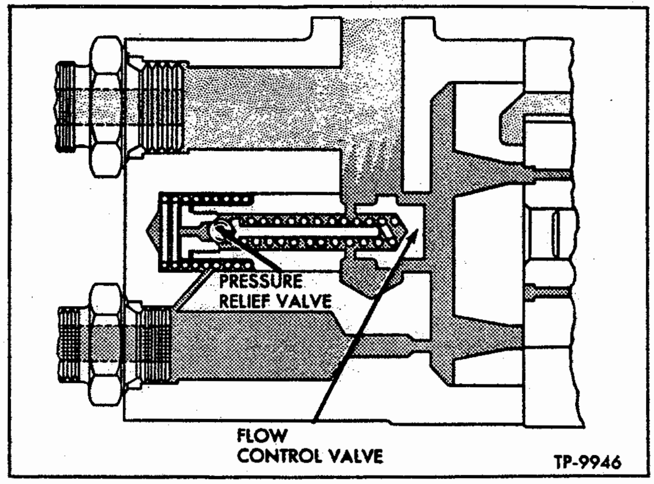


Figure 23—Flow Control Valve Operation at High Vehicle Speed

7. Make sure calibrated orifice in flow control valve plug is open.

8. Check flow control valve spring and relief valve spring for free length, compressed length, distortion, or collapsed coils. (See "Specifications.")

9. Inspect oil passages in pump body, cover, pressure plate, and cover to body ring for obstructed passages. Clean passages if this condition is found.

10. Check locating pins (34) for distortion.

ASSEMBLY

NOTE: Key numbers in text refer to figure 18.

Lubricate each moving part with clean hydraulic fluid before part is installed. When assembling power steering pump use new gaskets and O-ring seals.

1. If flow control valve assembly (fig. 24) has been disassembled, assemble parts, making sure same number of shims are installed as were removed. These shims control pressure at which relief valve opens to 950-1000 psi pressure. Tighten relief adjusting screw to 80-100 in. lbs. torque.

2. If drive shaft outer bearing (2) was removed from drive shaft (3), press bearing on shaft,

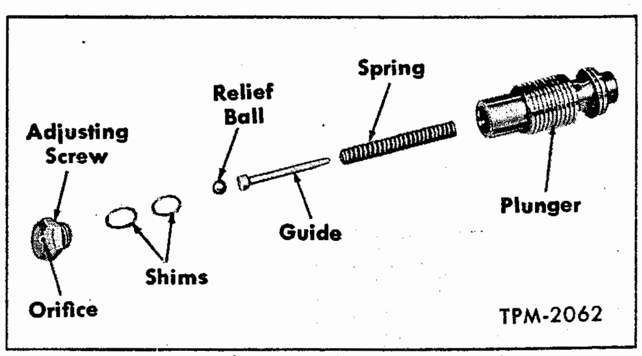


Figure 24—Flow Control Valve

using a sleeve with 1" I.D. Install bearing on shaft with stamped face of inner race toward threaded end of shaft.

3. If drive shaft inner bearing (36) was removed from pump body (35), install bearing in pump body by tapping lightly on bearing outer race. Make sure bearing is fully seated in pump body.

4. If bearing oil seal (4) was previously removed from pump body (35), install new oil seal in bore of pump body. Use a sleeve with 1-5/8" diameter to bear against outer edge of seal when driving into position. Install seal with stamped side facing out. Make sure seal is properly seated in pump body.

5. Install drive shaft (3) and outer bearing (2) in bore of pump body (35). Tap lightly on outer race of bearing until bearing is fully seated; then install snap ring (1) in pump body.

6. If locating pins (34) were removed at pump disassembly, install new pins in pump body (35).

7. Install new sealing ring (8) in groove of pump body (35).

8. Install pump rotor (33) over splines of drive shaft (3); then position vanes in slots in rotor with beveled edges of vanes facing seal ring (8).

9. Carefully position pump body to cover ring (32) over pump rotor (33) and vanes (9) in alignment with mark made at disassembly. NOTE: Observe body to cover ring (32) which has arrows cast onto outer edge. Pump body to cover ring (32) must be positioned on locating pins (34) with these arrows

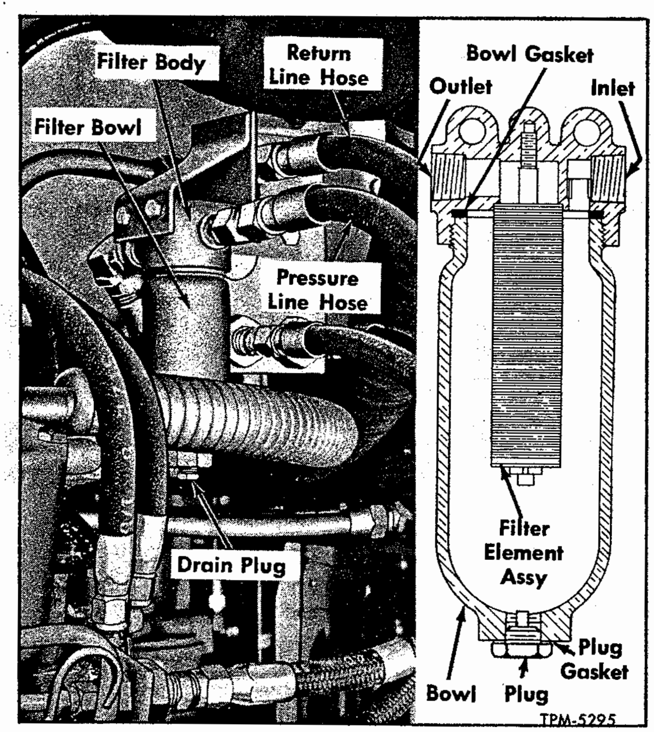


Figure 25—Power Steering Fluid Filter

pointed in a counterclockwise direction when pump is viewed from the drive end (fig. 19).

10. Position pressure plate (31) over locating pins (34) and against pump body to cover ring (32) in alignment with marks made at disassembly.

11. Place new "O" ring seal (28) around pressure plate surface of pump body to cover ring (32).

12. Install new seal ring (27) in groove of spring retainer plug (24); then install plug into bore of pump cover (20). Secure plug with snap ring (25).

13. Position flow control valve spring (29) and flow control valve (30) in bore of pump cover (20).

14. Place pump cover (20) over pressure plate (31) and against pump body to cover ring (32) aligning pump cover with pump body.

15. Install four bolts (23 and 26) attaching pump cover to pump body. Tighten bolts evenly and firmly to 25-30 ft. lbs. torque. Turn pump rotor drive shaft to check for freeness.

16. Install drive shaft key (37) in slot of rotor drive shaft (3). Secure with tape.

17. If flexible line union fittings and O-ring seals were removed from pump, install new seals and fittings in pump cover. Plug or mask fittings to keep dirt or foreign material out of pump until pump is ready to be installed on engine.

18. Position new gaskets (5 and 21) and gasket spacers (6 and 22) on pump using caution to avoid dropping spacers into pump.

19. Align reservoir tank (10) on pump assembly; then secure tank to pump with four screws (7).

NOTE: Position oil baffle (19) over oil return hole at bottom of reservoir. Tighten screws to 3-1/2 to 4.0 ft. lbs. torque.

20. Position reservoir cover (12) and new cover gasket (11) on reservoir tank (10); then attach cover to tank using new retainer gasket (13), retainer (14), flat washer (15), lock washer (16), and cover bolt (17). IMPORTANT: Install retainer (14) with recess side down into cover and install flat washer (15) with slotted side also facing downward. Tighten cover bolt (17) securely.

21. Install dipstick assembly (18) in reservoir cover (12).

POWER STEERING FLUID FILTER

Power steering fluid filter assembly is bracket mounted to engine bulkhead (fig. 25).

At regular lubrication intervals, fluid filter bowl should be removed and element cleaned. Any time power steering fluid filter has been serviced, power steering hydraulic system should be bled. Refer to "Bleeding Power Steering Hydraulic System" explained earlier in this section.

SERVICING FILTER

NOTE: Filter can be serviced without removing complete assembly from coach.

1. Using a wrench, turn filter bowl out of threads of filter head.
2. Remove and discard filter bowl gasket.
3. Using a small wrench, unscrew filter element assembly from filter head. Use care to avoid damage to element. Clean, using compressed air.
4. Remove fluid filter drain plug from bottom of filter bowl. Clean all metallic material from plug magnets.
5. Reassemble filter, then bleed hydraulic system as directed earlier under "Bleeding Power Steering Hydraulic System."

SPECIFICATIONS

Steering Wheel Diameter . . . . 22"
Steering Bevel Gear Assembly
Ratio . . . . Manual . . . 1.5 to 1
Power. . . . 1 to 1
Backlash Adjustment Method . . . . . Shims
Shim Thickness
Upper Bevel Gear . . . . 0.003"-0.010"
Lower Bevel Gear. . . 0.003"-0.010"-0.0015"

STEERING GEAR-ASSEMBLY
Make . . . . Ross
Type . . . . Cam and Twin Roller Lever
Model . . . . TE 72014
CAMSHAFT
Mounting . . . . Ball Bearings
Adjustment . . . . . . Barely Perceptible Drag
Adjustment Method . . . . Shims
Shims Available 0.001"-0.002"-0.003"-0.010"
LEVER SHAFT
Mounting . . . . Roller Bearing
Adjustment . . . . Slight Drag at Mid-Position

LEVER SHAFT BEARING UNIT
Number Used 2
Bearing Type . . . . Roller
Quantity of Bearings (Ea. Unit) 32
Adjustment . . . . . . 3-3-1/2 in.-lbs. torque

STEERING PROPELLER SHAFT
Joint Series . . . . . . #1261 Slip - 1268 Fixed
Journal Diameter at Bearing . . 0.5955"-0.5960"
Bearing Race I.D. (Early Models) 0.7845"-0.7855"
(Late Models) 0.7843"-0.7850"
Number of Rollers 23
Roller Diameter . . . . 0.9355"-0.9375"
DRAG LINK
Type . . . . Adjustable Length

END SOCKET STUD SPRING
Free Length 3/4
Lbs. Pressure @ 1/2 350-400

POWER STEERING BOOSTER CYLINDER
Make . . . . Vickers
Model SP3-210B
Type . . . . Hydraulic
Adjustable Length (Disconnected and
Retracted) (Centerline of Ball Studs) 26-25/32"
Cylinder Tube - Inside Diameter . . . . 2.750"

Piston
Outside Diameter . . . . 2.748"
Clearance - Piston to Cylinder . 0.002"-0.010"
Ring Groove - Width . . . . . 0.187"-0.188"
Piston Ring
Width . . . . 0.1860"-0.1865"
Gap (Compressed to 2.750") . . 0.007"-0.017"
Piston Rod
Finish . . . . Chrome Plated
Diameter . . . . 1.1245"
Piston Rod Bushing (In Cylinder Cap)
Inside Diameter . . . . 1.128"-1.129"
Outside Diameter . . . . . . 1.378"-1.379"
Booster Cylinder Extension and End Socket
Adjusted Length - (Centerline End Socket
Tapered Stud to Outside Edge of Flange) 19.69"

POWER STEERING PUMP
Make . . . . Vickers
Model VT8-100-40-95-10-LH
Type . . . . Vane
Capacity Per Minute . . . 4 Gal. at 1200 RPM
and 0 Pressure
Reservoir Tank Capacity . . . . . . 140 cu. in.
Pump Rotor
Width . . . . 0.6139"
Diameter . . . . 1.588"-1.598"
Vane Slot Width . . . . . . 0.0780"-0.0785"
Number Vane Slots 12
Rotor Vanes
Quantity 12
Thickness . . . . 0.0775"
Width . . . . 0.343"
Length . . . . 0.6136"
Outer Bearing
Type . . . . Single Row Ball
Make N.D.-954211
Outside Diameter . . . . . 1.8499"-1.8504"
Inside Diameter . . . . . . 0.7874"-0.7870"
Inner Bearing
Type . . . . Single Row Ball
Make N.D.-903201
Outside Diameter . . . . . 1.2593"-1.2598"
Inside Diameter . . . . . 0.4721"-0.4724"

Control Valve
Opening Pressure . . . . . . 950 to 1000 psi

STEERING SYSTEM SPECIFICATIONS (Cont'd)

SPRINGS

WHERE USED	APPROXIMATE FREE LENGTH	COMPRESSED LENGTH
Check Valve Ball	1.059"	7/8" Under 0.4 lbs.
		13/16" Under 0.536 lbs.
Cylinder Ball Stud Dust Cover	7/8"	3/16" Under 40-50 lbs.
Booster Cylinder Stud Seat	23/32"	1/2" Under 238 lbs.
Booster Cylinder Oil Passage Tube	0.536"	3/8" Under 9 lbs.
Booster Cylinder Inner Valve Centering	1.042"	0.843" Under 54 lbs.
		0.718" Under 88 lbs.
Booster Cylinder Valve Center Centering	1.044"	0.843" Under 106 lbs.
		0.718" Under 172 lbs.
Booster Cylinder Valve Outer Centering	1.293"	1.093" Under 160 lbs.
		0.968" Under 260 lbs.
Pump Flow Control	2.506"	0.906" Under 6.25 lbs.
		9.531" Under 7.7 lbs.
Pump Control Valve Relief	1.591"	1-5/16" Under 19.6 lbs.
		1-9/32" Under 21.78 lbs.
Horn Button	1-23/64"	51/64" Under 4 lbs.
Lever Shaft	1-3/4"	1/2" Under 50 lbs.
Pump Drive Coupling Spring	25/32"	5/16" Under 15 lbs.

Transmission

Mechanical transmission (fig. 1), has four forward speeds and one reverse. All mainshaft, reverse idler, and countershaft gears have helical cut teeth and are in constant mesh. Interlocking (sliding) clutches with spur teeth on inner diameter slide on corresponding teeth on clutch gears.

Power is transmitted from transmission to propeller shaft through a spiral bevel gear angle drive unit which comprises part of transmission assembly.

Transmission is attached to and supported by engine clutch housing. When necessary to service transmission, access to unit is gained through engine compartment doors at rear of the vehicle.

The terms "Front" and "Rear" as used in following description and illustrations do not apply to the mounted position of transmission in coach. Following the common usage of those terms - "Front" applies to clutch end of transmission, while "Rear" applies to propeller shaft end.

Key numbers in text refer to figures 1 and 2.

MAINSHAFT AND GEARS

Mainshaft (29) is supported at rear end by opposed tapered roller bearings (24 and 27) mounted in angle drive case end cover (18). Mainshaft center roller bearing (40) mounted in main case (72) directly in front of bevel pinion (32), supports mainshaft at that point. Front of mainshaft is supported by main drive gear pilot roller bearing (81) mounted in pocket of main drive gear (77). Main drive gear is supported in main case (72) by single row ball bearing (75).

Mainshaft 3rd and 4th speed clutch gear (65) is mounted on splined portion of mainshaft and held in place with mainshaft gears retaining nut (74) and lock washer (84). First and 2nd speed clutch gear is integral with mainshaft.

Mainshaft 1st (102), 2nd (97), and 3rd (93) speed constant mesh gears are each mounted on double row needle bearings. Rows of bearings are separated by spacers.

COUNTERSHAFT AND GEARS

Countershaft (49) is supported at rear by single row ball bearing (50) held on shaft with two lock nuts (46 and 48) and lock washer (47). Front end of shaft is supported on countershaft front roller bearing (75) which is prevented from coming out of case by clutch housing (91). Inner race of roller bearing (67) is held on shaft by countershaft front bearing nut (69) and retaining washer (68).

Countershaft drive gear (64) and countershaft 3rd speed gear (62) are keyed to shaft and separated by spacer (65). Countershaft 2nd speed gear (60) and countershaft clutch gear (58) are integral with shaft.

Countershaft 1st speed gear (54) is not keyed to shaft, but is carried on bronze bushing (53) and is driven by countershaft sliding clutch (57) carried on countershaft clutch gear. Countershaft sliding clutch is operated by reverse shift fork and is engaged in all forward speeds.

REVERSE IDLER GEAR

Reverse idler driving and driven gears (55) and (59) are mounted on roller bearings, with two bearings in each gear separated by spacers.

Reverse idler gears are separate, revolving independently of each other in all forward speeds. Reverse idler driven gear is in constant mesh with countershaft 2nd speed gear (60) and reverse idler driving gear (55) is in constant mesh with mainshaft 1st speed gear (102). Reverse idler sliding clutch (56) is carried on hub of reverse idler driving gear, and engages both gears during reverse operation.

OIL PUMP

Transmission lubricant is circulated to various points by a conventional gear type oil pump mounted on rear side of angle drive case. Oil pump drive is accomplished by fitting end of oil pump shaft (44) into rear end of countershaft (49).

Oil pump drive gear (42) hubs project on both sides and fit into oil pump housing (43). Oil pump driven gear is bushed and turns on shaft (35) pressed into oil pump cover (33). Pump is fitted with spring loaded pressure relief valve, consisting of a ball (36) and spring (37) held in place by screw type plug (38).

SHIFTING MECHANISM

Selection of transmission gear is made by conventional shifting lever. Gearshift lever is mounted in a tower attached under floor near driver's seat. Two shift slides in base of gearshift lever tower are connected with control rods which run from front to rear of coach below floor. Adjustable yokes are provided at points where forward rods are attached to shift slides in lever tower and also where rear rods are connected with levers at transmission.

TRANSMISSION

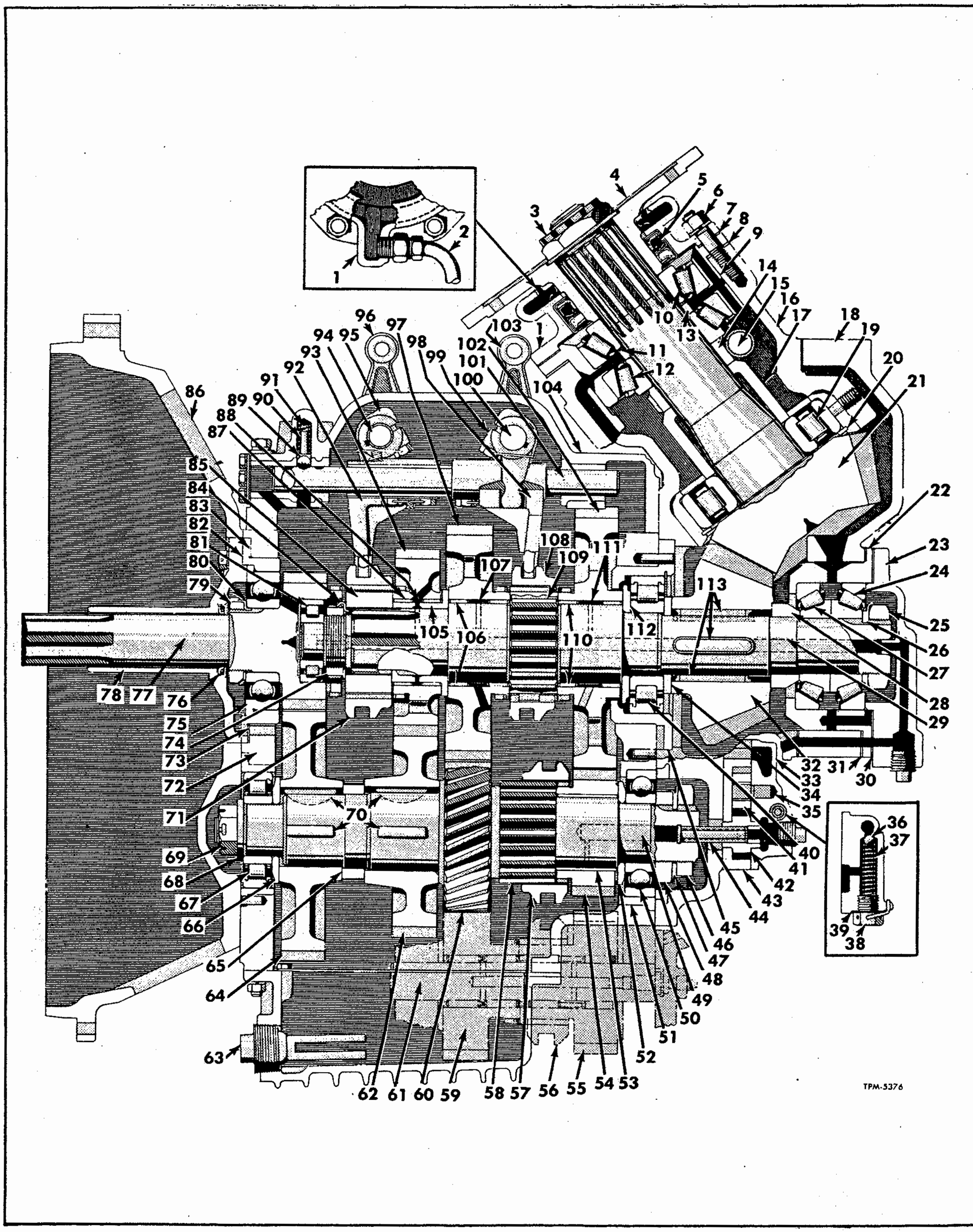


Figure 1—Sectional View of Transmission

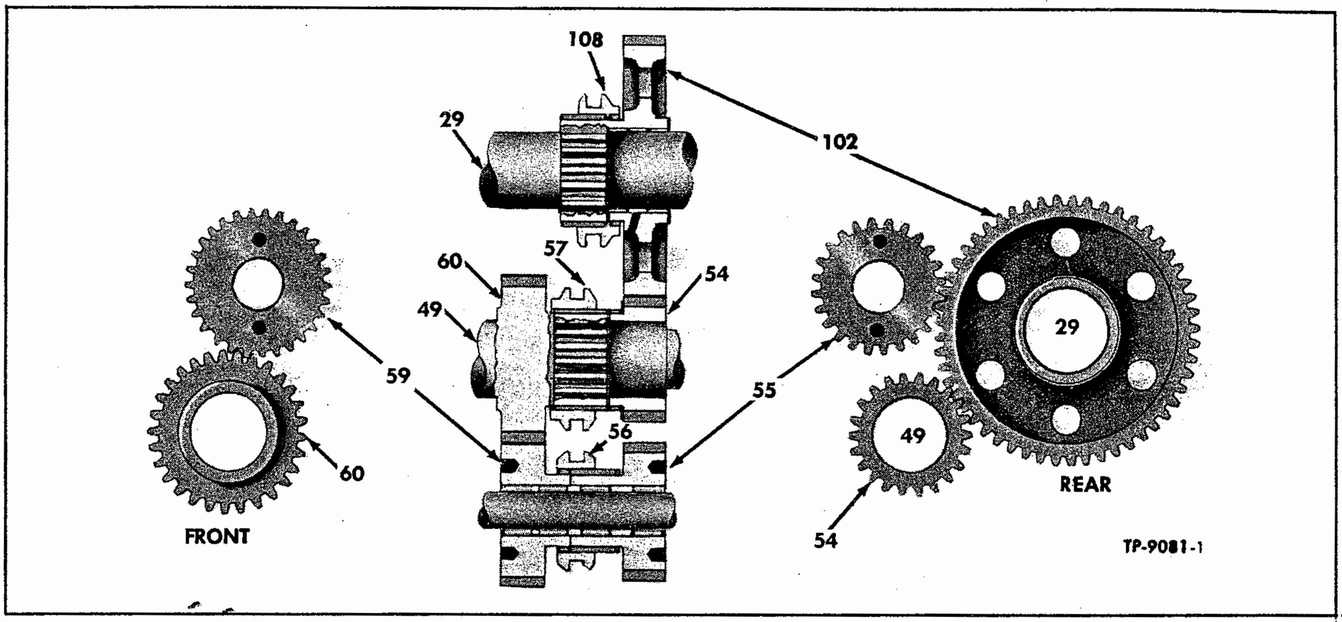


Figure 2—Position of Gears and Clutches in Reverse Operation

1 Bearing Cap
2 Bearing Cap Drain Tube
3 Propeller Shaft Flange Nut
4 Propeller Shaft Flange
5 Oil Seal
6 Bearing Cap Stud Nut
7 Gasket
8 Shims
9 Bearing Retainer
10 Angle Drive Outer Bearing
11 Shims
12 Angle Drive Inner Bearing
13 Bearing Spacer
14 Speedometer Drive Gear
15 Speedometer Driven Gear
16 Angle Drive Case
17 Spacer
18 Angle Drive Case Cover
19 Angle Drive Gear Roller Bearing
20 Snap Ring
21 Angle Drive Gear and Shaft
22 Bearing Retainer
23 Mainshaft Rear Bearing Cap
24 Mainshaft Bearing
25 Mainshaft Rear Bearing Nut
26 Lock Washer
27 Mainshaft Bearing
28 Bevel Pinion Rear Spacer
29 Mainshaft
30 Shims
31 Shims
32 Bevel Pinion
33 Oil Pump Cover
34 Bevel Pinion Front Spacer
35 Oil Pump Driven Gear Shaft
36 Relief Valve Ball
37 Relief Valve Spring
38 Relief Valve Plug
39 Relief Valve Plug Washer
40 Mainshaft Center Bearing
41 Oil Pump Driven Gear
42 Oil Pump Drive Gear
43 Oil Pump Housing
44 Oil Pump Drive Shaft
45 Mainshaft Bearing Retainer
46 Outer Nut
47 Lock Washer
48 Inner Lock Nut
49 Countershaft
50 Countershaft Rear Bearing
51 Countershaft Bearing Retainer
52 Countershaft 1st Speed Gear Thrust Washer
53 Countershaft 1st Speed Gear Bushing
54 Countershaft 1st Speed Gear
55 Reverse Idler Drive Gear
56 Reverse Idler Sliding Clutch
57 Countershaft Sliding Clutch
58 Countershaft Clutch Gear
59 Reverse Idler Driven Gear
60 Countershaft 2nd Speed Gear
61 Reverse Idler Shaft
62 3rd Speed Countershaft Gear
63 Magnetic Drain Plug
64 Countershaft Drive Gear
65 Spacer
66 Drive Gear Retaining Washer
67 Countershaft Front Bearing
68 Bearing Retaining Washer
69 Countershaft Bearing Retaining Nut
70 Countershaft Gear Key
71 3rd and 4th Speed Sliding Clutch
72 Transmission Main Case
73 Bearing Retainer Gasket
74 Mainshaft Nut
75 Main Drive Gear Bearing
76 Oil Seal
77 Main Drive Gear
78 Main Drive Gear Bearing Cap
79 Bearing Lock Nut
80 Lock Washer
81 Mainshaft Pilot Bearing
82 Shims
83 Bearing Retainer
84 Nut Lock Washer
85 3rd and 4th Speed Clutch Gear
86 Clutch Housing
87 3rd Speed Gear Bearings
88 Spacer
89 Poppet Ball
90 Plunger
91 Spring
92 3rd and 4th Speed Shift Fork
93 3rd Speed Gear
94 3rd and 4th Speed Shift Shaft
95 3rd and 4th Speed Shift Finger
96 3rd and 4th Speed Shift Lever
97 Mainshaft 2nd Speed Gear
98 1st and 2nd Speed Shift Fork
99 1st, 2nd, and Reverse Shift Finger
100 1st, 2nd, and Reverse Shift Shaft
101 1st, 2nd, and Reverse Shift Rod
102 Mainshaft 1st Speed Gear
103 1st, 2nd, and Reverse Shift Lever
104 Main Case Cover
105 3rd and 4th Speed Gear Thrust Collar
106 2nd Speed Gear Bearing
107 Bearing Spacer
108 1st and 2nd Speed Sliding Clutch
109 1st and 2nd Speed Clutch Gear
110 1st Speed Gear Bearings
111 Bearing Spacer
112 1st Speed Gear Thrust Washer
113 Bevel Pinion Key

Captions for Figures 1 and 2

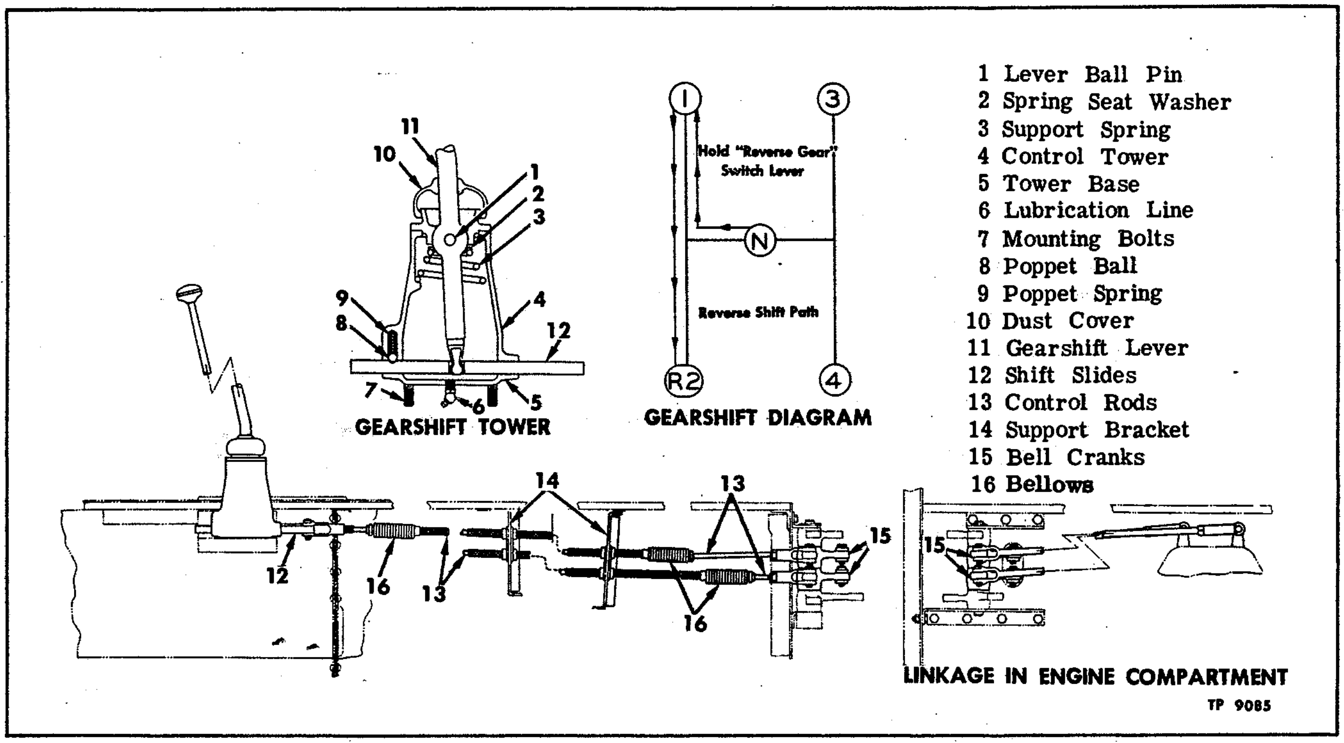


Figure 3—Transmission Controls and Linkage

When shift is made for any one of four forward speeds (fig. 3) the movement of shift lever is transmitted to transmission through various rods, levers, and bell cranks.

Transmission control rods from shifting lever to bulkhead are supported as illustrated in figure 3. Rods pass through loom packed with commercial graphite.

Rods and loom are supported in rubber grommets in support brackets. Make all control rod adjustments with controls in neutral.

REVERSE SOLENOID AND RELAY

The reverse solenoid, mounted on the transmission assembly is used to furnish pulling force to move shift finger into engagement with notch in reverse speed shift fork.

Reverse solenoid has two coils, one known as a pulling coil and the other referred to as holding coil. Electrical circuit to solenoid is completed by means of solenoid relay mounted in regulator compartment. Relay is in turn controlled by "Reverse Gear" switch at panel in front of driver. Relay control circuit is protected by circuit breaker No. 5 located in circuit breaker panel at left of driver. Refer to "Relays" in "WIRING AND MISCELLANEOUS ELECTRICAL" (SEC. 7) for information pertaining to maintenance and adjustment of relay.

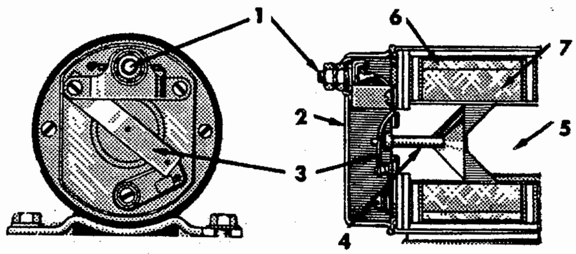
When gearshift lever is in 1st speed position the shift finger (19, fig. 7) is in line with notch in reverse speed shift fork, hence operating the "REVERSE GEAR" switch at this time causes reverse solenoid to operate, thereby moving finger into engagement with reverse shift fork (fig. 5).

As gearshift lever is moved through reverse shift path (fig. 3) the reverse idler drive and driven gears are locked together by clutch and at same time countershaft 1st speed gear is disengaged from countershaft to become an idler gear during reverse operation.

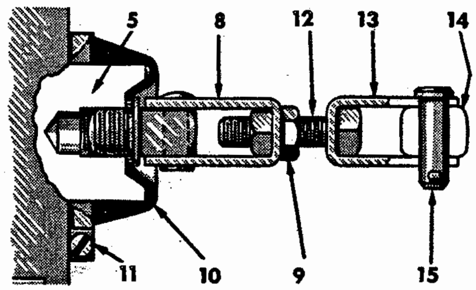
Both coils in reverse solenoid (fig. 4) are energized to move the shift finger in transmission, but as solenoid plunger reaches end of its travel it strikes a pin which opens a set of points thereby breaking circuit through pulling coil. The holding coil remains energized however, and will hold the solenoid plunger in as long as driver presses the reverse switch button. Refer to Engine Control and Generator wiring diagram in back of manual for arrangement of wiring, junctions, and circuit breaker.

OIL SEALS

Spring loaded synthetic rubber type oil seals are used at main drive gear bearing cap (76) and at output shaft bearing cap (5). Spring loaded leather oil seals are used at three points on shift shafts in transmission cover. See figure 7, items 11, 16, and 26.



SECTIONAL VIEWS OF REVERSE SOLENOID



SOLENOID LINKAGE

1 Wire Terminal
2 Cover
3 Contact Points
4 Pin
5 Plunger
6 Holding Coil
7 Pulling Coil
8 Link Assembly
9 Lock Nut
10 Dust Shield
11 Clamp
12 Adjusting Bolt
13 Clevis
14 Lever
15 Clevis Pin

TP 2938

Figure 4—Reverse Solenoid and Linkage

Before leather seals are installed, they should be soaked in "Neatsfoot" oil or warm engine oil until leather portion of seal is soft and pliable. This procedure will insure an efficient leak-proof seal and also assists in installation. Seal assemblies should be replaced at overhaul.

OPERATION

Key numbers in text refer to figures 1 and 2.

Forward speeds are shifted manually by means of shift lever interconnected to transmission shift tower by control rods and levers (fig. 3).

This section describes the path by which power flows through the transmission assembly as vehicle is operated. Shifting diagram shown in figure 3 may be referred to for gearshift lever position for each transmission speed.

FIRST SPEED

The 1st and 2nd speed sliding clutch (108) is engaged with mating teeth on mainshaft 1st speed gear (102). Power flow is from main drive gear (77) to countershaft drive gear (64), through countershaft (49) to countershaft 1st speed gear (54), to mainshaft 1st speed gear through sliding clutch (108) and clutch gear (109) to mainshaft (29), through mainshaft to angle drive gears and output shaft (29).

SECOND SPEED

First and 2nd speed sliding clutch (108) is engaged with mating teeth on mainshaft gear (97). Power flow is main drive gear (77) to countershaft drive gear (64), to 2nd speed gear (60), to mainshaft 2nd speed gear (91), to clutch (108) and clutch gear (109), to mainshaft (29), through mainshaft to angle drive gears and output shaft (21).

THIRD SPEED

The 3rd and 4th speed sliding clutch (71) is engaged with mating teeth on mainshaft 3rd speed gear (93). Power flow is from main drive gear (77) to countershaft drive gear (64), through countershaft (49) to countershaft 3rd speed gear (62) and through sliding clutch (71) and clutch gear (85) to mainshaft, through mainshaft to angle drive gears and output shaft (21).

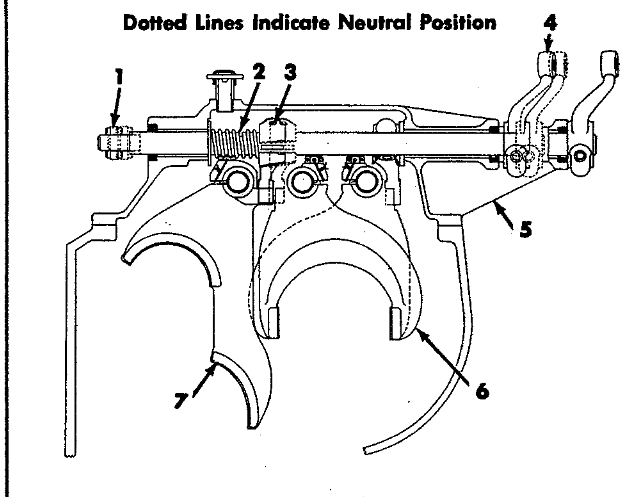
FOURTH SPEED

The 3rd and 4th speed sliding clutch (71) is engaged with mating teeth at rear of main drive gear (77). Power flow is directly through sliding clutch (71) and clutch gear (85) to mainshaft and to angle drive gears and output shaft (21).

REVERSE SPEED

A solenoid (21, fig. 7), controlled by "Reverse Gear Switch" on panel in front of driver, is used in conjunction with gearshift lever to shift transmission for reverse operation. Arrows on gearshift diagram in figure 3 indicate the path through which the lever must be moved to shift transmission gears for reverse operation. Reverse gear switch is operated when gearshift lever is at first speed position and must be held while lever is moved to "R2" position. Figure 5 illustrates movement of shift shaft as solenoid is energized.

Solenoid lever engages collar (1) on shift shaft and as shaft and shift finger (3) move to the position indicated by solid lines (fig. 5), finger (3) is disengaged from fork (6) and enters notch in reverse shift fork (7). Shifting gearshift lever to "R2" position moves reverse fork forward disengaging sliding clutch on countershaft and engaging sliding clutch on reverse idler gears. Reverse

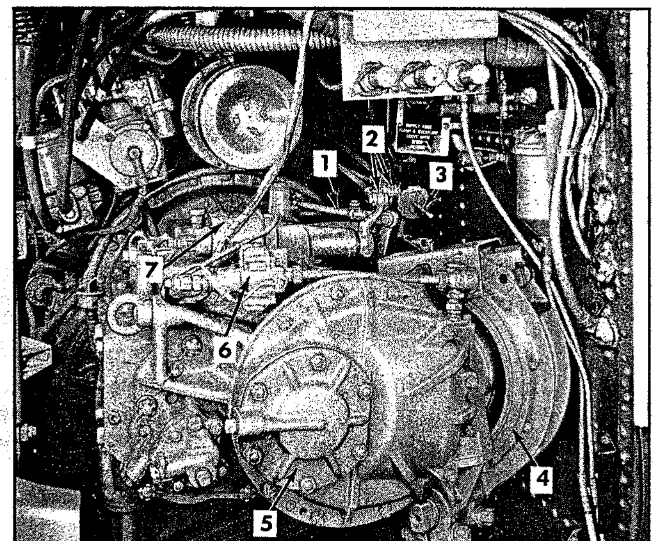


1 Solenoid Lever Collar
2 Reverse Lockout Spring
3 Shift Finger
4 First, 2nd, and Reverse Shift Lever
5 Transmission Cover
6 First and 2nd Speed Shift Fork
7 Reverse Speed Shift Fork
TP-9083

Figure 5—Position of Parts When Shifting into Reverse

gear switch must be held until shift into reverse is completed.

Figure 2 shows position of gears and clutches for reverse operation, and power flow is: Main drive gear (77) to countershaft drive gear (64), through countershaft to 2nd speed gear (60), to reverse idler driven gear (59) and drive gear (55), to mainshaft 1st speed gear (102), through sliding clutch (108) to mainshaft, thence to angle drive gears and output shaft.



1 Hand Brake Control Rod
2 Transmission Control Rods
3 Clutch Control Rod
4 Hand Brake Shoes
5 Transmission Assy.
6 Speedometer Sending Unit
7 Reverse Solenoid
TPM-5387

Figure 6—Transmission Installed

MAINTENANCE ON VEHICLE

The light maintenance operations covered in this paragraph include items which should be periodically inspected, and those minor repairs and adjustments which may be accomplished without removing transmission from vehicle.

TRANSMISSION CONTROL ROD ADJUSTMENT

Provisions are made for adjustment of control rod length by use of adjustable yokes. When replacing transmission or any of the control linkage, before attempting to operate vehicle, be sure linkage is adjusted as follows:

1. Place gearshift lever in neutral position; then move transmission gears into neutral position by operating levers (96 and 103), (fig. 1).
2. Adjust control rod end yokes so that clevis pins can be inserted without moving rods or levers from neutral position. Make certain lock nuts are tightened after adjustment has been made.

REVERSE SOLENOID LINKAGE ADJUSTMENT

Whenever the reverse solenoid has been removed, of if difficulty is experienced when shifting transmission into reverse speed, the following procedure will properly adjust the solenoid linkage:

1. Make certain transmission control rod linkage is correctly adjusted.
2. Place shift lever in first speed position.
3. Remove cover from rear of reverse solenoid, and inspect contact points. If points are burned or pitted, replace points or dress with a fine cut point file.
4. Manually shift reverse solenoid lever into reverse speed position (fig. 5).
5. Adjust lock nuts on solenoid link screw so that solenoid points just break, with the 1st, 2nd and reverse speed shift shaft moved fully into reverse speed position (fig. 5).

INSPECTION OF TRANSMISSION

1. Check lubricant level as directed in LUBRICATION (SEC. 13), and add or drain and refill with lubricant specified.
2. Inspect all gaskets and check for leaks. Tighten all nuts and bolts attaching covers, oil pump, plates etc., if evidence of lubricant leaks are found.
3. Remove and clean breather (vent) on top of transmission cover. Check bearing cap drain tube (2, fig. 1) and clean out any obstructions which may be found.

REPLACEMENT

REMOVAL

Key numbers in text refer to figure 6.

1. Open engine compartment doors, and remove dust shields below transmission assembly. Remove right rear bumper extension.

2. Disconnect propeller shaft from rear axle assembly; then unscrew dust cap at slip joint and remove propeller shaft.

3. Remove bolts from each end of cradle diagonal strut, then remove strut below transmission.

4. Disconnect control rods (3) from transmission levers. Remove clutch lever and hand brake lever pull-back springs, then disconnect hand brake rod and clutch control rod (2) from levers at clutch housing.

5. Disconnect wiring from reverse solenoid (8) and from speedometer sending unit (7).

SAFETY CAUTION

Before proceeding with steps below, block coach body securely. When attaching hoist to take weight of transmission, the coach body may be inadvertantly raised just enough to cause height control valve to exhaust, in which case entire weight of rear end of coach will be placed on hoist.

6. Attach hoist to transmission to support the assembly as mounting bolts are removed. Remove clutch housing to flywheel housing bolts and position starter cable (1) so it will not interfere with removal of transmission.

7. Carefully move transmission assembly away from engine. Assembly must move straight away until transmission drive gear is free from clutch disc hub. Remove transmission assembly through right compartment door.

8. Refer to pertinent information in BRAKES (SEC. 4) for information covering removal of hand brake mechanism from transmission assembly. Construction of clutch release mechanism is illustrated in CLUTCH (SEC. 5).

INSTALLATION

Key letters in text refer to figure 6 unless otherwise indicated.

NOTE: Whenever transmission is removed, the position of clutch levers should be checked using gauge as directed in CLUTCH (SEC. 5).

1. Assemble clutch release mechanism at clutch housing referring to CLUTCH (SEC. 5) for necessary information. Apply lubricant on splined portion of main drive gear as directed in LUBRICATION (SEC. 13).

2. If hand brake mechanism has been removed, assemble components at transmission and bolt universal joint in place at transmission output shaft. Refer to BRAKES (SEC. 5) for pertinent information regarding assembly and adjustment of hand brake mechanism.

3. Move transmission into position with drive gear aligned with splines in clutch driven disc. Install clutch housing to flywheel housing bolts with starter cable clips in original positions.

4. Install propeller shaft referring to PROPELLER SHAFT (SEC. 18) for necessary information.

5. Connect wiring at reverse solenoid (8) and speedometer sending unit (7).

6. Connect shift rods at respective levers at transmission cover. Connect clutch control lever and hand brake control rod, then hook up return springs. Adjust clutch pedal free-travel and check operation of gearshift mechanism.

7. Install engine cradle diagonal strut below transmission and install dust shields. Install bumper extension (6).

8. Be sure transmission is filled to level mark on dip stick with recommended lubricant. Refer to LUBRICATION (SEC. 13) for lubricant information.

CONTROL TOWER REPLACEMENT

Gearshift lever, mounted in control tower below floor at right of driver can be removed and disassembled as described in these instructions. Refer to figure 3 for layout of control rods.

REMOVAL

1. Open compartment door at left front corner of coach and disconnect clutch pedal return spring from bracket below transmission lever tower.

2. Remove pins which connect control rods to shift slides in base of control tower.

3. Remove nuts and washers from mounting bolts which extend downward from control tower base, and secure the tower to support bracket.

4. Remove support bracket bolts, then remove tower assembly through compartment door.

5. If necessary to disassemble gearshift lever tower, the cap may be removed from top of tower to permit removal of lever, and the four bolts may be removed at bottom of the assembly to permit removal of shift slides and poppets.

INSTALLATION

1. Assemble gearshift lever tower components referring to sectional view in figure 3 for construction. Mounting bolts are installed from upper side of tower and are threaded into base.

2. Install tower assembly through compartment at left front corner of coach. Move assembly into position with gearshift lever and top of tower entered in hole in coach floor.

3. Install mounting bracket bolts, and install

nuts and lock washers on tower to bracket bolts.

4. Connect transmission control rods to slides in tower. Secure clevis pins with new cotter pins.

5. Hook clutch pedal return spring to tower bracket. Check control rod adjustment.

DISASSEMBLY

Key numbers in text refer to figure 1.

The disassembly procedures which follow should be used to disassemble transmission components with minimum of time and effort. Receptacles for cleaning the parts, and compressed air for drying should be available. Parts must be clean to permit careful inspection.

1. Remove clutch release mechanism from clutch housing and remove hand brake mechanism and universal joint at transmission output shaft. Reverse solenoid and lever and speedometer sending unit should also be removed from transmission assembly before using cleaning solutions or steam in cleaning exterior surfaces.

2. Thoroughly clean all dirt and accumulations from transmission case then mount the assembly in suitable repair stand and drain out transmission lubricant.

3. Remove fifteen cap screws and lock washers, then lift to remove main case cover (104) with shift forks and shafts. Remove four stud nuts and lock washers, then remove oil pump from rear of transmission.

4. Remove six nuts and lock washers, then remove mainshaft rear bearing cap (23). Cap has two slots at outer edge so that screwdriver may be used to pry cap from retainer (22). Do not use extreme force when prying cap. Note quantity of shims (30) used between cap and retainer. Tag shims so that original pack may be used when reassembling.

5. Lock mainshaft by engaging both first and third speed gears.

6. Straighten out lips of lock washer (26) and remove mainshaft rear bearing nut (25) with special wrench (Tool No. 80-0223). This nut has left-hand threads and is marked with letters "L.H." to distinguish it from countershaft nut.

7. Remove rear bearing retainer (22) with bearings. Retainer is provided with tapped holes in which puller screws may be used. Note quantity of shims (31) used between retainer and angle drive case cover (18). Tag shims so that original pack may be used when reassembling.

8. Remove angle drive case cover (18). Two dowel pins are used to locate angle drive case cover to angle drive case (16).

9. Remove two cap screws and eight stud nuts then remove angle drive case with angle drive gear and shaft assembly (28) from main case (72).

10. Remove lock wire and seven stud nuts which attach clutch housing to transmission; then remove clutch housing, together with clutch release parts.

11. Tapped hole in rear end of reverse idler shaft is provided to withdraw shaft from case. As shaft is withdrawn, gears, bearings, spacers and thrust washers will be stripped from shaft.

12. Pull mainshaft bevel pinion (32) from mainshaft with special puller (Tool No. 80-0161). Puller must grasp pinion firmly or pinion teeth will be damaged. Spacer (28) will be removed as pinion is pulled from mainshaft.

13. Remove mainshaft center bearing retainer (45) with bearing (40) and thrust washer (112), and pinion spacer (34). Retainer has slots on outer edge so that screwdriver may be used to assist in its removal. Bearing and thrust washer may be pressed from retainer if necessary after removing bearing snap ring.

14. Remove six stud nuts and lock washers, then remove main drive gear bearing cap (78) and oil seal (76). Remove and tag shims (82) so that original parts may be used at assembly.

15. Remove main drive gear (77) with bearing (75) and bearing retainer (83). Use screws in tapped holes provided in retainer to start drive gear bearing retainer from case. Remove pilot bearing (81) from mainshaft.

16. Tie mainshaft gears together to hold them in place while removing mainshaft from case. Lift mainshaft and gears from case.

17. Straighten lips of lock washer (47) and remove countershaft rear bearing lock nuts (46 and 47).

18. Force countershaft (49) toward rear until rear bearing retainer flange is exposed, then pull rear bearing (50) and retainer (51) from countershaft.

19. Remove first speed gear (54) and thrust washer (52) from countershaft through bearing hole in case.

20. Move countershaft toward rear until shaft clears front bearing (67), then remove countershaft with gears through top of case.

DISASSEMBLY OF SUBASSEMBLIES

Key numbers in text refer to figure 1 unless otherwise indicated.

MAINSHAFT DISASSEMBLY

1. Untie gears and remove first speed gear (102), first and second speed sliding clutch (108) and third and fourth speed clutch (71).

2. Raise tangs on lock washers (84) and remove lock nut (74) from end of mainshaft.

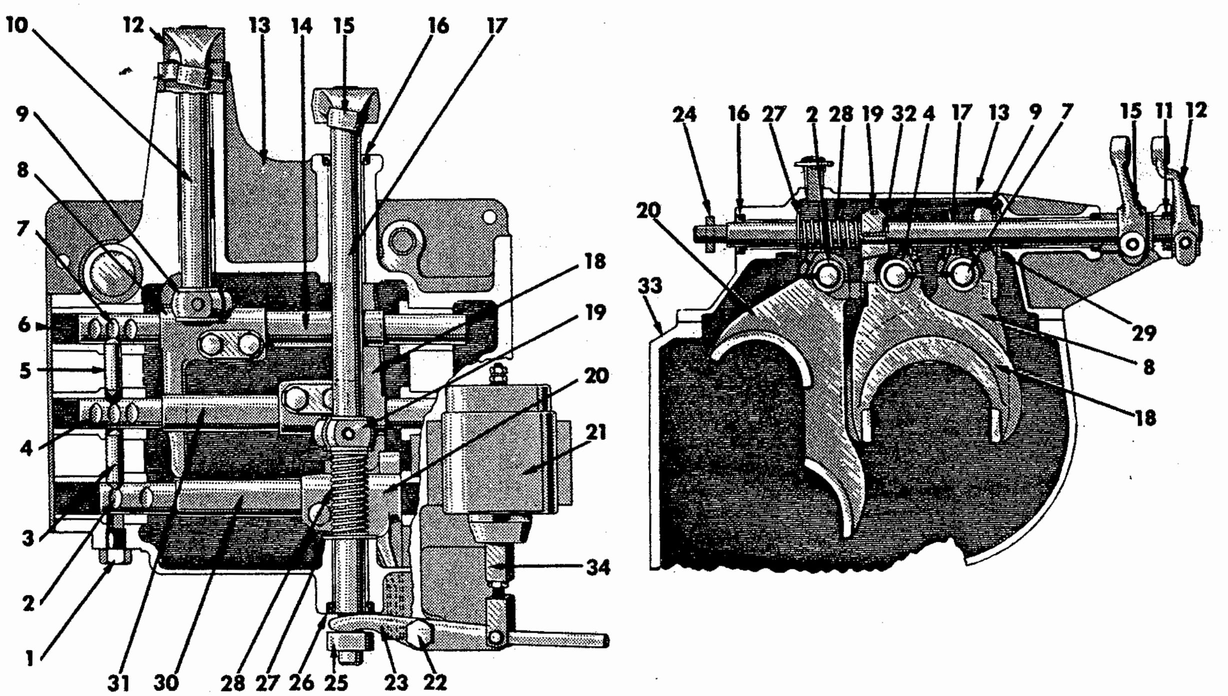
3. Remaining gears, thrust washers, bearings and spacers may be stripped from mainshaft.

COUNTERSHAFT DISASSEMBLY

1. Remove low speed gear sliding clutch (57).
2. Remove front bearing nut (69) and washer (68).
3. Remove front bearing inner race (67) and retaining washer (66). Bearing and outer race need not be removed unless bearing is to be replaced. In that event, use a suitable tool to remove bearing from case.
4. Drive gear (64), spacer (65) and gear (62) may be pressed off countershaft separately.

ANGLE DRIVE DISASSEMBLY

1. Remove propeller shaft flange nut (3), then remove propeller shaft flange (4) with suitable puller.
2. Remove bearing cap (1) with oil seal (5). Slots are provided in cap so screwdriver may be used as a pry.
3. Remove bearing retainer (9), with outer bearing cone (10) and bearing cup. Tapped holes are provided in retainer so that puller screws may be used as a puller. Note quantity of shims (8) used between bearing retainer and angle drive case (16). Tag shims so that original pack may be used when reassembling. Also note quantity of shims (11) used between bearings (10 and 12). Tag these as well so that original pack may be used when reassembling.
4. Remove speedometer driven gear (15).
5. Remove bevel drive gear (21) from angle drive case.
6. Inner tapered bearing (12), speedometer



PLAN VIEW

SECTIONAL VIEW FROM REAR

1 Interlock Pin Plug
2 Reverse Speed Rod
3 Interlock Pin
4 1st and 2nd Speed Rod
5 Interlock Pin
6 Shift Rod End Plate
7 3rd and 4th Speed Shift Rod
8 3rd and 4th Speed Shift Fork
9 3rd and 4th Speed Shift Finger
10 3rd and 4th Speed Shift Shaft
11 Oil Seal
12 3rd and 4th Speed Shift Lever
13 Cover
14 Stop Sleeve
15 1st, 2nd, and Reverse Speed Shift Lever
16 Oil Seal
17 1st, 2nd and Reverse Speed Shift Shaft
18 1st, and 2nd Speed Shift Fork
19 1st, 2nd, and Reverse Speed Shift Finger
20 Reverse Speed Shift Fork
21 Reverse Solenoid
22 Solenoid Shift Lever Screw
23 Reverse Solenoid Shift Lever
24 Collar Pin
25 Solenoid Fork Collar
26 Oil Seal
27 Washer
28 Reverse Lockout Spring
29 Washer
30 Stop Sleeve
31 Stop Sleeve
32 Shift Finger Key
33 Transmission Main Case
34 Solenoid Linkage

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Figure 7—Transmission Cover and Shifting Mechanism

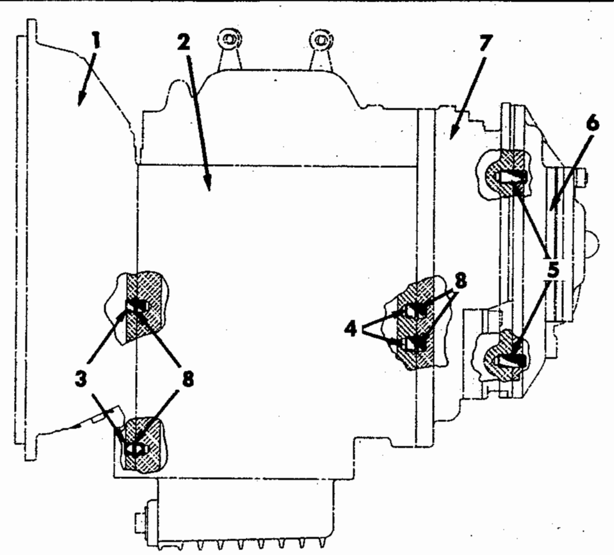
drive gear (14), spacer (17) and straight bearing (19) may be stripped off shaft.

7. Bearing (19) outer race may be removed from case after snap ring (20) has been removed.

MAIN CASE COVER DISASSEMBLY

Key numbers in text refer to figure 7, unless otherwise indicated.

1. Remove shift rod end plate (6).
2. Remove clamp screws from shift forks.
3. Remove shift rods (2, 4, and 7) from cover, stripping off forks (20, 18, and 8) and stop sleeves (30, 31, and 14) as rods are removed.
4. Remove plug (1) from cover (13) and strike cover sharply on block of wood to remove interlock pins (3 and 5).
5. Remove clamp screws from third and fourth speed shift finger (9) and remove finger from shaft (10). Finger is held to shaft with key.
6. Shaft (10) with lever (12) may then be removed from cover.
7. Solenoid shift lever (23) may be removed from cover by removing lever screw (22).
8. Remove pin (24) from first, second and reverse shaft (17), then remove collar (25).
9. Remove clamp screw from first, second and reverse shift finger (19).
10. Remove shaft (17) with lever (15) from cover, stripping off reverse spring (28) washers (27 and 29) and finger (19). Finger is held with key.



1 Clutch Housing
2 Transmission Case
3 Clutch Housing to Transmission Case Dowel Pins
4 Transmission Case to Rear Case Dowel Pins
5 Rear Case to Cover Dowel Pin
6 Rear Case Cover
7 Transmission Rear Case
8 Dowel Pin Snap Rings

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Figure 8—Transmission Case Dowel Pins

CLEANING AND INSPECTION

Clean all parts carefully in gasoline or suitable cleaning fluid and blow dry with compressed air.

All bearings should be cleaned thoroughly. After bearing assemblies have been soaked in cleaning fluid, tap them sharply on a block of wood to dislodge any solid particles. Slush them again in cleaning fluid and blow dry with air. Do not spin the bearings with the air - revolve them slowly in races with fingers as air is directed at right angles to the balls or rollers. Examine races and bearings for pits and scores, then oil each assembly thoroughly with clean engine oil.

Individual needle bearing rollers which were removed from main shaft gears should be thoroughly washed and inspected. Replace those bearing rollers which show signs of scores or pits. (There are 138 rollers to each gear.)

Examine teeth on all gears carefully for nicks and worn spots. Do not take chances with gears which are appreciably nicked or scored. Small nicks may be carefully removed with a "slipstone" or hone.

Clean interior of main case thoroughly. Remove magnetic drain plug and clean all particles of metal from magnet. Blow out all oil passages with compressed air.

CASES AND DOWEL PINS

Key numbers in text refer to figure 8.

Clutch housing and transmission angle drive case are held in proper alignment with transmission main case by dowel pins (fig. 8). Two dowels (3) are used at front of main case and two (4) are used at rear of the main case. Angle drive case cover (6) which supports mainshaft rear bearing is also dowelled onto angle drive case.

In the original assembly the transmission serial number appearing on main case name plate is also stamped on angle drive case and cover. It is of utmost importance when assembling transmission that transmission cases are not interchanged with corresponding parts from other transmissions. ALWAYS MATCH CASES BY REFERRING TO SERIAL NUMBER.

SERVICE INFORMATION

Transmission main cases, angle drive cases and covers and clutch housings furnished for replacement are standard production parts. Oversize dowel pins are available and must be used to overcome any possible misalignment of dowel pin holes when a new transmission main case, angle drive case, cover, or clutch housing is being assembled with original parts or vice versa. Before installing oversize dowel pins, it will be necessary

to enlarge and ream existing holes with parts bolted together in correct relationship.

MAIN CASE TO ANGLE DRIVE CASE OVERSIZE DOWEL INSTALLATION

Accomplish the following operations when a new angle drive case is to be installed on original main case or vice versa.

1. Install mainshaft center bearing retainer in counterbore at rear of main case. With angle drive case attaching studs in place, place angle drive case on main case and install stud nuts. Tighten stud nuts evenly and firmly to draw the cases together. Mainshaft center bearing retainer will act as a pilot to assure correct position of angle drive case on main case.

2. Using a drill slightly smaller than oversize dowel pin diameter, enlarge the dowel pin holes. Then ream dowel pin holes to size given in "Specifications" at end of this section.

3. Remove stud nuts and separate the two cases; then add counterbore in angle drive case to accommodate oversize dowel pin snap rings (8,fig. 8).

4. Press or drive oversize dowel pins into holes in main case with snap rings contacting surface of case.

ANGLE DRIVE CASE COVER INSTALLATION

Key numbers in text refer to figure 1.

Accomplish the following operations in the event that new angle drive case is to be installed with original angle drive case cover or vice versa. Perform operations which follow with transmission drive gear and mainshaft installed in main case and the angle drive case assembled on main case.

1. Press mainshaft rear bearings (27 and 24) into retainer (22) then bolt bearing and retainer assembly and cap (23) onto angle drive case cover.

2. Install angle drive case cover on angle drive case, guiding rear bearing over rear end of mainshaft to locate cover on case. Strike angle drive case cover with soft faced hammer to seat cover against angle drive case then install stud nuts finger tight. Rotate mainshaft to insure positive alignment of cover with mainshaft, then tighten cover retaining nuts.

3. Using a drill slightly smaller than standard dowel pin diameter (refer to "Specifications") drill new dowel pin holes through pin boss in cover and into angle drive case to depth of at least 1 inch, being careful to avoid original holes.

4. Line ream new holes to 0.6525" to 0.6550" then remove cover and enlarge holes in cover to 0.6565" to 0.6570".

5. Remove angle drive case cover and press or drive oversize dowel pins into new holes in angle drive case.

CLUTCH HOUSING (Fig. 1)

If clutch housing is replaced with new part, ream dowel pin holes in new part to size listed in "Specifications" at end of this section, using bearing cap (78) installed on main case as a pilot for locating clutch housing.

ASSEMBLING SUBASSEMBLIES

Procedures as outlined in following paragraphs should be followed in order to assemble transmission with minimum time and effort.

Key numbers in text refer to figure 1, unless otherwise indicated.

COUNTERSHAFT ASSEMBLY (Fig. 1)

1. Press third speed countershaft gear (62) onto shaft with long hub of gear toward front. Make certain that both keys are in position and keyways are free from burrs.

2. Place spacer (65) and keys (70) in position and press drive gear (64) onto shaft with long hub of gear toward rear.

3. Install drive gear retaining washer (66) with recessed edge toward bearing (67).

4. Install front bearing inner race (67), retaining washer (68) and nut (69). Tighten nut securely and install cotter pin.

5. Install front bearing (67) into case if it has been removed.

6. Install sliding clutch (57) over countershaft clutch gear (58) with long hub toward front. Do not install first speed gear (61) at this time.

MAINSHAFT AND DRIVE GEAR ASSEMBLY (Fig. 1)

1. Place mainshaft in vise with rear end of shaft down (vise should be equipped with "soft" jaws).

2. Make sure second speed gear (97) is thoroughly clean, especially on inside diameter, then apply a coat of heavy gear oil. Place gear over mainshaft with gear teeth toward rear.

3. Install 69 roller bearings (106) in hub of gear. Install bearing spacer (107) and push bearings and spacer in position. Then install another row of roller bearings.

4. Install third speed gear thrust collar (105) and install third speed gear (93) and bearings (87) in same manner as second speed gear, except that gear teeth are toward front.

5. Install third and fourth speed clutch gear (25) over splines of mainshaft with chamfered end of splines toward rear. Install sliding clutch (71) over gear (85) with extended edge of gear toward rear.

6. Install washer (84) and retaining nut (74) and tighten nut firmly. Bend lock washer over flat of lock nut.

7. Reverse position of shaft in vise and install first and second speed sliding clutch (108) with extended edge of gear toward rear.

8. Install first speed gear (102) over mainshaft with gear teeth toward front. Install roller bearings (110) and spacer (111) in same manner as previously described for second and third speed gears.

9. Remove mainshaft with gears from vise.

10. Coat inner face of thrust washer (112) with grease and place in position. Grease will prevent washer from sliding out of place when assembly is lowered into case and in that manner prevent bearings from falling out when shaft is tilted for installation. It is also a good practice to temporarily wire the two large gears together to hold them in place while installing shaft.

11. Press bearing (75) into retainer (83), then install the assembly on main drive gear (77).

12. Install lock washer (80) and nut (79). Tighten nut securely and bend tangs of lock washer over flats of nut.

OIL PUMP ASSEMBLY (Fig. 1)

Oil pump may be readily assembled in following manner:

1. Insert hexagonal drive shaft (44) in end of countershaft (49).

2. Install gasket and oil pump housing (43) over studs and drive shaft.

3. Install drive gear (42) in housing, with drive bushing end of gear over drive shaft.

4. Press driven gear shaft (35) into cover (33) if it has been removed.

5. Assemble driven gear (44) over shaft (35).

6. Fill cover and housing with lubricant and assemble cover, with gasket, to housing.

7. Install nuts with lock washers and tighten securely.

8. Fill pressure relief valve hole with lubricant and rotate drive shaft (44) in proper direction while filling until all passages are filled with lubricant, and air is displaced. Unless oil pump is filled with lubricant, it may not pick up when first started, thereby chances of damage to transmission through lack of lubricant are increased.

9. Install pressure relief valve ball (36), spring (37), and plug (38).

10. Lock plug with lock wire.

ANGLE DRIVE ASSEMBLY (Fig. 1)

1. Install drive gear straight roller bearing (19) on shaft. Be sure bearing seats firmly against gear.

2. Install spacer (17), speedometer drive gear (14), inner tapered roller bearing cone (12), spacer (13) and original shim pack (11).

3. Install bearing cups (10 and 12) in retainer (9). Be sure cups are firmly seated against shoulder of retainer.

4. Place retainer with bearing cups over inner tapered bearing cone (12) and install outer tapered bearing cone (10).

5. Install propeller shaft flange (4) and nut. Tighten nut securely.

6. Correct bearing adjustment will allow retainer (9) to turn freely but not spin. Increase or decrease shim pack (11), between bearing cones, as necessary to provide correct bearing adjustment.

7. Remove nut (3), propeller shaft flange (4) and retainer (9) with outer bearing (10). Protect shim pack (11) so it will not be disturbed until assembled in case.

8. Install straight roller bearing outer race (19) and snap ring (20) in angle drive case if they have been removed.

9. Place bevel gear and shaft (21) in position in angle drive case (16) and install retainer (9) with original shim pack (8) and outer bearing (10). Do not install bearing cap (1).

10. Install propeller shaft flange (4) and tighten nut (3) securely.

MAIN CASE COVER ASSEMBLY

Key numbers in text refer to figure 7.

1. Install first, second and reverse shaft (17) and lever (15) into cover (13), assembling shift finger key, shift finger (19), finger clamp screw, washer (29), reverse lock-out spring (28) and washer (27) as shaft is moved into position. Refer to figure 7 for position and relation of parts.

2. Install solenoid shift lever collar (25), and pin (24) in end of shaft.

3. Install third and fourth speed shift shaft (10) and lever (12) into cover and assemble finger key, shift finger (9) and clamp screw.

4. Insert third and fourth speed rod poppet spring, plunger and poppet in cover (13). Third and fourth rod is upper rod in figure 7, or right-hand rod when transmission is installed in vehicle and may be identified by three poppet notches closely spaced with recesses for fork clamp screws nearer poppet notches.

5. Insert 3rd and 4th speed rod (7) into cover (13) assembling spacer (14) and fork (8) as shown in figure 7, as rod is moved into position.

6. Install fork clamp screws and tighten securely.

7. Shift 3rd and 4th speed rod into neutral, install interlock pin (5) moving it down to rod (7).

8. Insert 1st and 2nd speed rod poppet spring, plunger and poppet in cover (13). First and 2nd rod is center rod and may be identified by three poppet notches closely spaced with recesses for fork clamp screws farther away from poppet notches.

9. Insert 1st and 2nd rod (4) into cover, assembling fork (18) and spacer (31) as shown in figure 7 as rod is moved into position.

10. Install fork clamp screw and tighten securely.

11. Shift 1st and 2nd speed rod into neutral, install interlock pin (3) and move it down to rod (4).

12. Insert reverse rod poppet spring, plunger and poppet into cover. Reverse rod is bottom or left-hand rod and may be identified by having only two poppet notches.

13. Insert reverse rod (2) into cover, assembling fork (20) and spacer (30), as shown in figure 7, as rod is moved into position.

14. Install fork clamp screw and tighten securely.

15. Install interlock pin plug (1) in cover.

16. Install shift rod end cover gasket and cover (6).

ASSEMBLY

Key numbers in text refer to figure 1 unless otherwise indicated.

Accomplish operations which follow in sequence given, referring to figures 1, 2, and 7 for position of parts.

COUNTERSHAFT INSTALLATION

1. Place countershaft and gear assembly into case, tilt front end upward and lower rear end into case, inserting rear end through rear bearing hole in case far enough to permit front end to be inserted into front bearing (67).

2. Install first speed gear (54) on countershaft by inserting gear through rear bearing hole in case.

3. Install thrust washer (52), recessed edge toward bearing (50).

4. Press rear bearing (50) into retainer (51). Be sure retainer dowel pin is in place, then install bearing and retainer, being careful to align notch in retainer with dowel pin in case.

5. Install inner lock nut (48) and tighten securely.

6. Install lock washer (47) and outer nut (46). Tighten nut and lock both nuts by bending lips of washer over flats of nuts.

REVERSE IDLER GEAR INSTALLATION

Refer to figure 2 and note position and width of spacers installed, at ends and in between roller bearings. Install reverse idler shaft in following manner:

1. Drive shaft into case just far enough to install thrust washer, driven gear, bearings and spacers. Make sure that oil passages in shaft are clean and that plug in end of shaft is in place.

2. As shaft is driven into case, install remaining parts. Front thrust washer fits in notch in case.

3. After shaft is driven into case, tongue on outer end of shaft must be in vertical position, to register with recess in angle drive case.

MAINSHAFT AND MAIN DRIVE GEAR INSTALLATION

1. Tilt front end of mainshaft and gears assembly upward and lower rear end into transmission case and out through center bearing hole in case.

2. Place pilot bearing (81) on front end of mainshaft.

3. Using a new gasket (73) under retainer flange, install main drive gear and bearing assembly in case. Holes through retainer flange must be aligned with tapped holes in case. Also be sure gasket does not obstruct oil return passage.

4. Install new oil seal (76) in main drive gear bearing cap (78) and replace cap using same thickness of shims (82) as was removed at disassembly.

NOTE: Outer race of bearing (75) must be held tight by bearing cap (78). The thickness of shims (82) should be .002 inch less than space existing between bearing cap (78) and retainer flange when measured with a feeler gauge.

5. Insert main drive gear (77) and bearing (75) assembly into place and while working main drive gear bearing retainer into case, hold mainshaft in alignment so that pilot bearing (81) will enter pocket of main drive gear. In order to facilitate assembly of main drive gear, one person should hold mainshaft in alignment, while other is installing drive gear and bearing.

6. Remove thrust washer (112) at rear end of mainshaft and install center bearing retainer (45).

NOTE: This bearing retainer is located on case with one dowel driven into case. Dowel fits in a milled recess in retainer. The other slots or recesses in retainer are for the purpose of removing part.

7. Reinstall thrust washer (112), recessed edge toward bearings, and press center bearing (40) into place.

8. Install bevel pinion spacer (34) over rear end of mainshaft. Spacer is available in three sizes. See "Specifications" at end of this section.

9. Replace bevel pinion keys (113) and install bevel pinion (32).

ANGLE DRIVE (Fig. 1)

1. Angle drive case (16) is held to main case (72) by studs. Cases are located and held in alignment by dowel pins held in place by snap rings. Install new gasket and assemble angle drive case, with bevel gear and shaft, to main case. Make sure

that pinion (32) and gear (21) teeth are matched as marked, that dowel pins are in place and that milled end of reverse idler shaft fits into milled slot in case.

NOTE: In the event new angle drive case or main case is being installed, ream dowel pin holes in new part to size shown in "Specifications" at end of this section.

ANGLE DRIVE CASE COVER (Fig. 1)

1. Install angle drive case cover (27) using new gasket. Be sure dowel pins are in place. Draw studs up evenly and securely.

NOTE: Be sure dowel pins are in good condition.

MAINSHAFT REAR BEARING (Fig. 1)

Mainshaft Rear Bearing Adjustment (Fig. 1)

Correct adjustment of mainshaft rear bearing is obtained in following manner:

1. With bearing retainer (22) removed from transmission, install bearing (27 and 24) and cups in retainer.
2. Assemble bearing cap (23) with original shims (30). Attach cap to retainer with suitable bolts.
3. Increase or decrease shims (30) between cap (23) and retainer (22) until retainer will turn freely on bearings but will not spin.
4. Disassemble and protect shims selected for use at reassembly.

Installing Mainshaft Rear Bearing

1. Install mainshaft rear bearing spacer (28).
2. Install rear bearing retainer (22) with inner bearing cup. Do not install shims (31) between retainer and angle drive case cover (18).
3. Install bearing cones (24 and 27), lock washer (26) and nut (25). Draw nut up tightly.
4. Install puller screws in tapped holes in retainer (22).
5. While holding inner rear bearing (27) tight against its cup, adjust puller screws in retainer (22) until mainshaft and countershaft gears line up.
6. Measure space between retainer (22) and cover (18) with feeler gauge and select proper thickness of shims (31). If this thickness becomes greater than .035 inch, remove pinion (32) and replace spacer (34) with one of sufficient thickness to bring shim pack thickness to less than .030 inch.
7. Remove retainer (22) and reassemble, installing shims selected.
8. Install outer bearing cup (24) and cap (28) using shims (30) between cap and retainer as previously determined when bearing adjustment was made.
9. Check alignment of gears again.

ANGLE DRIVE GEAR BACKLASH (Figs. 1 and 9)

1. With transmission completely assembled with the exception of shims (8) between drive gear bearing retainer (9) and angle drive case (16), also bearing cap (1) not assembled, install puller screws in bearing retainer (9) and adjust backlash to dimensions shown on gears. Refer to "Specifications" if marks on gears are not legible. See backlash sketch in bottom corner of figure 9.
2. Measure space between retainer (9) and angle drive case (16) with feeler gauge.
3. Select proper shim thickness and install shims, assembling retainer, bearing (10), cap (1) with new oil seal (5), flange (4) and nut (3).
4. Tighten flange nut and cap stud nuts (6) securely.
5. Check backlash in gears again and correct if necessary by adding or removing shims (8).

ANGLE DRIVE GEAR TOOTH CONTACT (Figs. 1 and 9)

1. To check for proper tooth contact paint several teeth on pinion (32) with ground red lead mixed with a few drops of engine oil. Rotate mainshaft by hand in same direction as when operating in forward speed, applying tension at propeller shaft flange at same time. Gears may be seen through filler hole in top of angle drive case (16).
2. Tooth contact impression should start at toe of tooth and extend back about 80% of tooth length toward heel on drive side of tooth. Contact should be distributed evenly over flank and face of tooth indicating center of contact on pitch line. Refer to diagrams "A" and "B" in figure 9.
3. If tooth contact is too far out on tooth (diagram "C" figure 9), reduce shim thickness at (8) between bearing retainer (9) and angle drive case (16) moving gear (21) toward pinion (32). Restore backlash by reducing shims (31) between bearing retainer (22) and angle drive case cover (18).
4. If tooth contact extends back from toe appreciably less than 80% of tooth length (diagram "D" figure 9), move gear (21) away from pinion (32) by adding shims at (8). Restore backlash by adding shims at (31).
5. If contact is low on flank of tooth (see diagram "E" figure 9) move pinion (32) away from gear (21) by reducing shims at (31). Restore backlash by reducing shims at (8).
6. If contact is high on face of tooth (diagram "F" figure 9), move pinion (32) toward gear (21) by adding shims at (31). Restore backlash by adding shims at (8).

OIL PUMP INSTALLATION

1. Using new oil pump gasket, install pump assembly on transmission, guiding drive shaft (44) into socket at rear of countershaft (49).

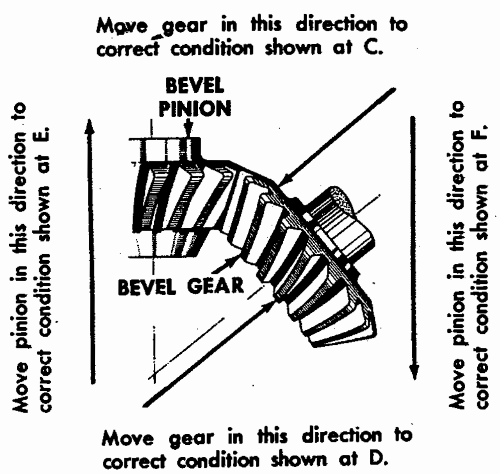
INSTRUCTIONS

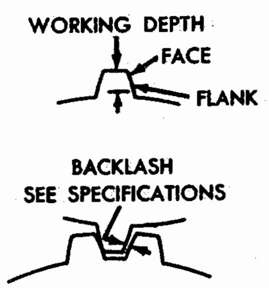
1—Install bevel pinion and bevel gear assemblies; then adjust pinion and bevel gear for proper backlash as directed in "Adjustments" paragraph of this section.

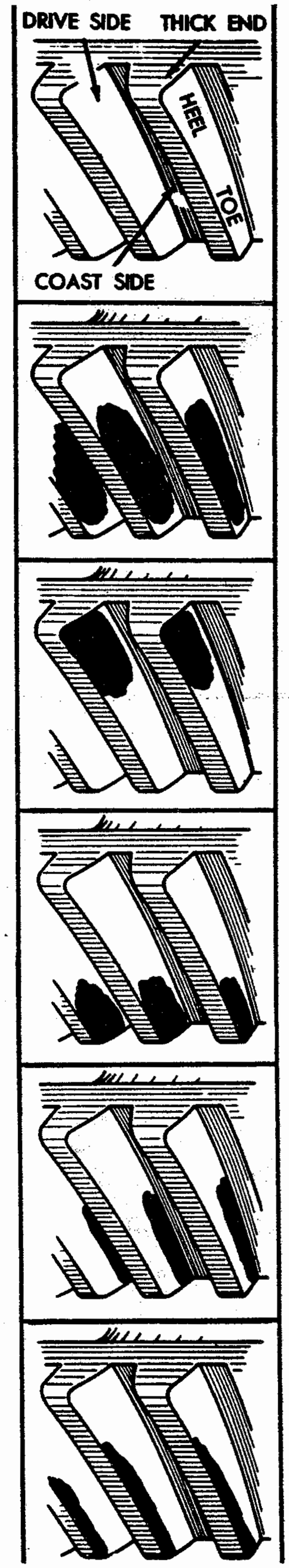
2—Paint three of four teeth of bevel gear on output shaft with red lead or mechanics' blue and rotate pinion until bevel gear makes complete revolution.

3—Note area of tooth contact which should start at toe and extend about 80 percent of tooth length toward heel, as at B.

4—Vary position of pinion and gear as per chart until proper tooth contact is obtained. Be sure that sufficient backlash has been allowed so that gear can be completely revolved without any highspots being felt.







A—Check adjustments at drive side of bevel gear tooth.

B—Shows correct tooth contact.

C—Shows short contact at heel. To correct, move gear toward pinion. Then move pinion away from gear to again secure correct backlash.

D—Shows short contact at toe. To correct, move gear away from pinion. Then move pinion toward gear to again secure correct backlash.

E—Shows heavy contact on flank or lower portion of tooth. To correct, move pinion away from gear until contact comes to full working depth of gear tooth without breaking contact at flank. Then move gear toward pinion to secure correct backlash.

F—Shows heavy contact on face or upper portion of tooth. To correct, move pinion toward gear until contact covers flank of tooth without breaking contact at face. Then move gear away from pinion to secure correct backlash.

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Figure 9—Gear Tooth Contact Chart

TRANSMISSION COVER INSTALLATION

1. Place levers (96 and 103) in neutral and move clutches (71, 108, 59, and 56) to neutral position.

2. With new cover gasket in place, lower cover assembly onto transmission case so that forks enter grooves in clutches.

3. Bolt cover in place. Install reverse solenoid assembly and lever (fig. 7) on transmission cover, and adjust solenoid linkage.

SPECIFICATIONS

SPICER MODEL NUMBER	7141-A
Speeds	Four Forward - One Reverse
Mounting	Unit
Gear Selection	Manual, Remote Control

GEAR RATIOS

Spicer Model	7141-A
Angle Drive Gears	1.00 to 1
First Speed	3.86 to 1
Second Speed	2.50 to 1
Third Speed	1.50 to 1
Fourth Speed (Direct)	1.00 to 1
Reverse	3.29 to 1

GEAR BACKLASH

Angle Drive Gears	0.008"-0.010"
Mainshaft and Countershaft Gears	0.006"-0.008"
Sliding Clutches and Clutch Gears	0.004"-0.007"
Oil Pump Gears	0.006"-0.008"

MAINSHAFT GEAR BEARING ROLLERS

Number of rollers per gear	138
Length	0.655"-0.675"
Lapped Diameter	0.12500"-0.12525"

BEARING ADJUSTMENTS

Angle Drive Gear Tapered Bearing
- See Instructions

SHIM THICKNESS AVAILABLE

Main Drive Gear Bearing Cap	0.003"-0.010"
Mainshaft Rear Bearing Retainer	0.010"-0.031"
Mainshaft Rear Bearing Cap	0.003"-0.010"
Angle Drive Gear Bearing Cone	0.003"-0.010"-0.030"
Angle Drive Gear Bearing Retainer	0.003"-0.010"-0.031"

SPACER THICKNESS

Bevel Pinion - Front (Available in 3 sizes)	0.230"-0.245"-0.260"
Bevel Pinion - Rear	0.938"-0.948"
Angle Drive Gear Bearing Cone	0.373"-0.377"

THRUST WASHER THICKNESS

Mainshaft 1st Speed Gear	0.262"-0.266"
Countershaft 1st Speed Gear	0.245"-0.249"
Reverse Gear - Front	0.182"-0.187"
Reverse Gear - Rear	0.185"-0.186"

COUNTERSHAFT 1ST SPEED GEAR BUSHING

Inside Diameter (As Serviced)	2.346"-2.349"
Inside Diameter (In Place) Grind to	2.3595"-2.3605"

OIL PUMP GEARS

Width	0.622"-0.623"

OIL PUMP DRIVE GEAR SHOULDER

Outside Diameter	0.8725"-0.8755"

OIL PUMP DRIVE GEAR SHOULDER BORE IN COVER AND HOUSING

Inside Diameter	0.8745"-0.8755"

OIL PUMP DRIVEN GEAR BUSHING

Length	0.610"-0.620"
Burnish to	0.4990"-0.5005"
Bushing to Shaft Clearance	0.001"-0.0035"

PRESSURE RELIEF VALVE SPRING

Free Length	2-7/16"
Pressure @ 2"	3 lbs. 8 oz. plus or minus 1-1/2 oz.

REVERSE SHIFT LOCK SPRING

Free Length	5-1/16"
Lbs. Pressure @ 1-3/4"	38-42

SERVICE DOWEL PINS AND HOLES

Clutch Housing to Main Case

Pin Diameter	0.8110"-0.8120"
Hole Dia. in Both Pieces	0.8070"-0.8095"

Main Case to Angle Drive Case

Pin Diameter	0.8110"-0.8120"
Hole in Both Pieces	0.8070"-0.8095"

Angle Drive Case to Angle Drive Case Cover

Pin Diameter	0.6555"-0.6560"
Hole Diameter in Angle Drive Case	0.6525"-0.6550"
Hole Diameter in Angle Drive Case Cover	0.6565"-0.6570"

TORQUE WRENCH SPECIFICATIONS

(Ft. Lbs.)

Companion Flange Nut	500
Mainshaft Nut	650

Propeller Shaft

Propeller shaft, used to transmit power from transmission to differential, is tubular type, equipped with heavy duty needle bearing-type universal joints.

Flange yoke, at slip joint end, is bolted to transmission angle drive companion flange (fig. 1). The shaft is splined to slip yoke, a steel dust cap which screws into slip yoke (fig. 4) prevents entry of dust.

Slip joint, at transmission end of shaft compensates for variations in distance between transmission and differential. These variations are brought about by the rise and fall of the rear axle as the vehicle passes over uneven ground.

Slip joints also facilitates removal of transmission or power plant. Flange yoke, at fixed joint end, is bolted to companion flange at differential. Shaft is welded to end yoke.

LUBRICATION

Trunnions of universal joints are drilled and provided with lubrication fittings, through which lubricant travels to all four oil reservoirs (fig. 2) and then, through a small hole in side of each reservoir, direct to needle bearings.

Needle bearings are protected against lubricant leakage and the entry of dust by gaskets.

Splines of slip joint are lubricated through lubrication fitting installed in slip yoke.

Universal joints and slip yoke splines should be lubricated periodically, as specified in LUBRICATION (SEC. 13).

PROPELLER SHAFT REMOVAL

Slip yoke and shaft are marked with arrows to insure correct alignment at assembly. Make sure arrows are clearly discernible, before disconnecting slip joint. If arrows are not visible, mark yoke and shaft distinctly.

Stub yoke at fixed joint is integral with shaft; therefore, replacement of yoke necessitates replacement of tube assembly, consisting of stub shaft, stub yoke, and tube. If propeller shaft and universal joints are to be removed, with transmission in place, proceed as follows:

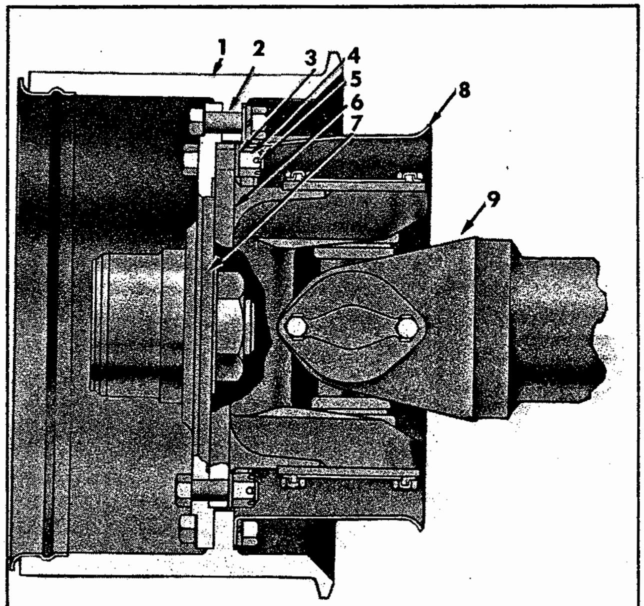
1. Remove lock wires, nuts and bolt washers which attach propeller shaft companion flange to companion flange at differential.
2. Unscrew slip joint dust cap. Make sure joint parts are properly marked for alignment as previously described.
3. Remove hand brake shoe assembly. Refer to "HAND BRAKE" (SEC. 4) for instructions.
4. Remove nuts and lock washers holding hand brake drum and oil shield to transmission companion flange (fig. 1).
5. Remove hand brake oil shield through hole in engine bulkhead.
6. Remove lock wire, nuts, and bolt washers holding propeller shaft companion flange to transmission companion flange (fig. 1).
7. Remove slip joint through hole in engine bulkhead; and remove shaft with fixed joint.

JOINT DISASSEMBLY

(Refer to Figure 2)

The following procedures apply to both the fixed and slip universal joint assemblies.

1. Bend lock strap free from bearing cap screws. Remove cap screws, lock straps, and bearing caps from yokes. NOTE: On some vehicles bearings are integral with cap. Do not permit needle bearings to drop on floor, since damage may result.



1 Hand Brake Drum
2 Brake Drum Bolt
3 Internal Tooth Lock Washer
4 Flange Bolt Nut
5 Lock Wire
6 Propeller Shaft Companion Flange
7 Transmission Companion Flange
8 Oil Shield
9 Universal Joint Slip Yoke

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Figure 1—Propeller Shaft Installation at Transmission

2. Tap yoke lightly on one end, with plastic or rawhide hammer, to dislodge bearings at opposite end. Continue until all bearings are removed.

3. Slide journal cross into one side of yoke as far as possible. Tilt journal to clear yoke and remove.

4. Slide gaskets from journal cross. Remove lubrication fitting from journal. Unless gasket retainers are to be replaced, do not remove retainers from journal.

CLEANING AND INSPECTION

PROPELLER SHAFT

Thoroughly clean old grease and dirt from splines of shaft; then inspect splines for wear. Refer to "Specifications" at end of this section.

Check shaft for warpage or breaks. If shaft is badly warped or broken, it should be replaced. Welding of broken shafts is not recommended, since this operation requires special facilities.

UNIVERSAL JOINT

Clean all parts with cleaning fluid. Thoroughly clean all lubricant passages in journal (fig. 2), and lubrication fittings. Soak needle bearing assemblies in cleaner to soften particles of hard grease. Clean bearing assemblies, using stiff brush; then blow out dirt with compressed air.

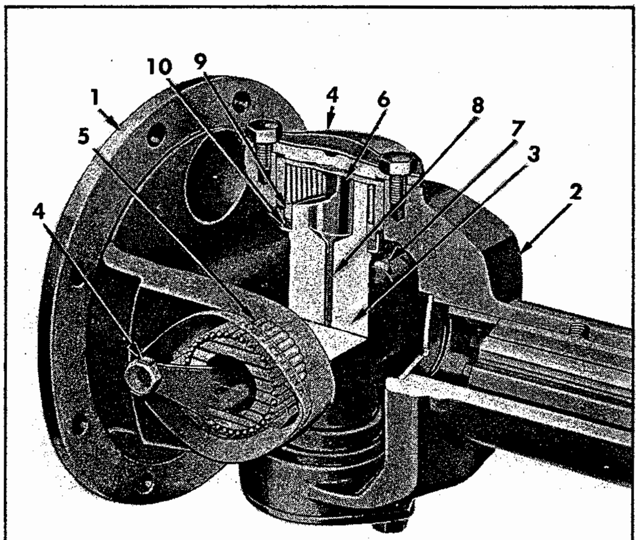
IMPORTANT: Make sure bearing assemblies are absolutely clean, since even extremely small particles of dirt or grit can cause excessive bearing wear. Do not attempt to disassemble needle bearings.

Inspect journal bearing surfaces for roughness or needle bearing grooves. If grooves and roughness will not clean up with moderate honing, journal and bearing assembly should be replaced. Carefully inspect each bearing assembly for wear and missing bearings (see "Specifications" at end of this section). Excessive wear is indicated if needles drop out of retainer, or if journal bearing surface shows marks of needles. If such conditions exist, needle bearing assembly should be replaced.

After needle bearing assemblies are thoroughly clean, pack with clean grease and turn on trunnion of journal to check wear. If excessive clearance is noted, further check of parts is necessary to determine which part to replace. Inspect gaskets and gasket retainers and replace if not in good condition.

SLIP JOINT

Carefully inspect yoke for cracks, wear or bent condition. Small burrs or rough spots can usually be removed with a hone. See "Specifications," at end of this section, for clearance between shaft and yoke splines. Replace, if defective or badly worn.



1 Yoke Flange	6 Oil Reservoir
2 Slip Yoke	7 Lubrication Fitting
3 Journal	8 Lubricant Passage
4 Lock Strap	9 Gasket
5 Needle Bearing Assembly	10 Gasket Retainer

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Figure 2—Universal Joint

JOINT ASSEMBLY

(Refer to Figure 2)

The following procedures apply to both the slip and fixed universal joint assemblies.

1. Install lubrication fitting in journal; then slide new gaskets on journal.

2. Insert one trunnion of journal into yoke as far as possible from inside, and tilt until opposite trunnion clears yoke and drops into position.

3. Lubricate bearings (1/3 full) with lubricant specified in LUBRICATION (SEC. 13). Insert bearing assemblies from outside of yoke and tap into place with rawhide or plastic hammer. DO NOT USE STEEL HAMMER FOR THIS PURPOSE. NOTE: Some vehicles are equipped with bearings that are integral with cap.

4. Care should be taken to insure that joints move freely in the bearings and do not bind. If joints should be tight, change bearings around until joints are all free in assembled position.

5. Install bearing caps (some vehicles), new lock straps, and cap screws. Tighten cap screws firmly; then lock screws by bending lock straps against screw heads.

PROPELLER SHAFT INSTALLATION

1. Insert slip joint end of propeller shaft through hole in engine bulkhead.

2. Position propeller shaft companion flange

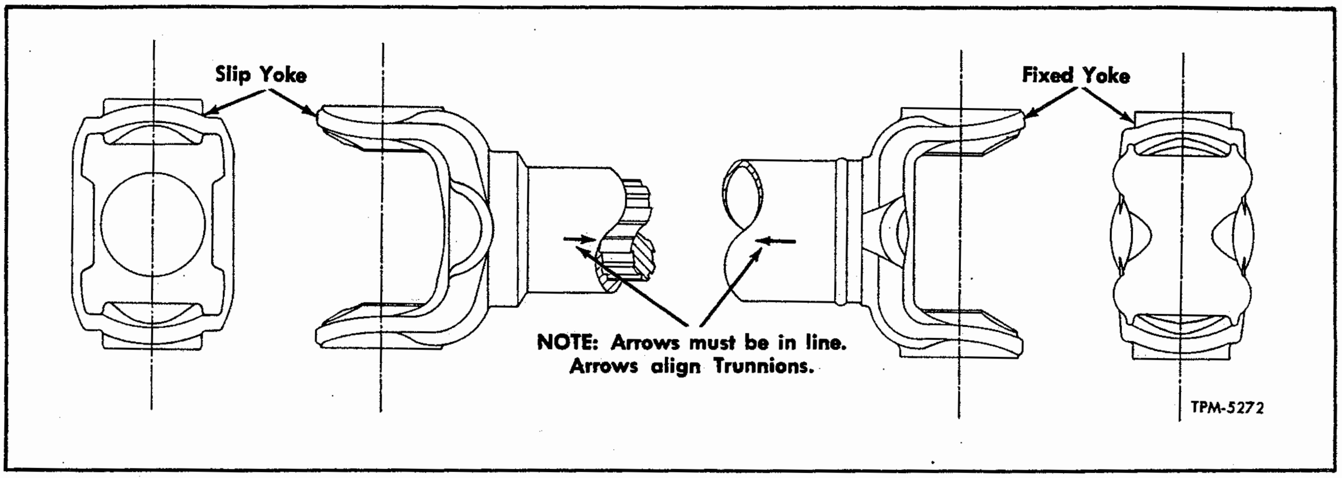


Figure 3—Yoke Alignment

to transmission companion flange; then install bolts, new bolt washers, nuts and new lock wires.

3. Insert hand brake oil shield through hole in engine bulkhead. Assemble shield and hand brake drum to transmission companion flange.

4. Install hand brake shoe assembly. Refer to "HAND BRAKE" (SEC. 4) for instructions.

5. Fixed joint end of propeller shaft may be inserted through clearance holes in frame and installed in slip joint as follows:

a. Align arrows on slip yoke and end yoke. Make sure yokes are exactly aligned, as shown in figure 3.

NOTE: If yokes are not correctly aligned, destructive vibration will occur when vehicle is in motion.

b. Place steel washer and cork washer on shaft between splines and dust cap at slip yoke end (fig. 4).

c. Insert end of shaft into slip yoke; then tighten dust cap by hand. Do not use wrench for this purpose as too much pressure will damage cork oil seal.

6. Position propeller shaft companion flange

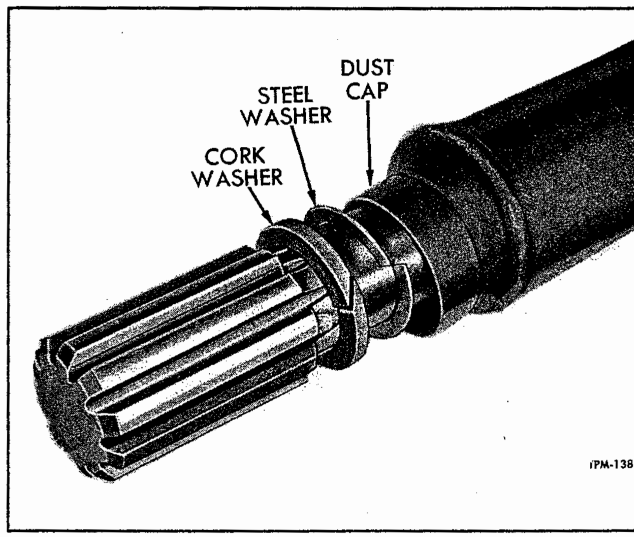


Figure 4—Propeller Shaft with Slip Joint Removal

to companion flange at differential and install bolts, new bolt washers, and lock wires.

7. Lubricate as in LUBRICATION (SEC. 13).

SPECIFICATIONS

Universal Joint Series (Slip Joint)	1701
Universal Joint Series (Fixed Joint)	1708
Shaft Diameter	3-1/2"
Journal Diameter	0.9980"-0.9985"
Bearing Rollers	
Number	36
Diameter	0.12475"-0.12500"
Length	0.920"-0.925"
Slip Joint	
Yoke Spline Thickness	0.3885"-0.3900"
Shaft Spline Thickness	0.3860"-0.3875"
Clearance - Shaft Splines to Slip Yoke Splines	0.001"-0.004"

Refer to LUBRICATION (SEC. 13)
for LUBRICATION INSTRUCTIONS.

Wheels, Hubs, and Tires

This group is divided into two sections covering Maintenance Information on "HUBS AND BEARINGS" and "WHEELS AND TIRES."

Hubs and Bearings

Wheels and hubs are carried on two opposed tapered roller bearings as shown in figures 1, 2, and 3. Bearings are adjustable for wear, and satisfactory operation and long life of bearings depend upon proper adjustment and correct lubrication. If bearing adjustment is too tight, bearings will overheat and wear rapidly. Loose adjustment of bearings will result in pounding, and will contribute to steering difficulties, uneven tire wear, and inefficient brakes. Before checking or adjusting wheel bearings, always be sure brakes are fully released and do not drag. Wheel studs are installed in hub flange as shown in figures 1, 2, and 3. Brake drums are mounted over wheel studs on outer side of hub flange and attached to hub with countersunk screws.

Front Left Hub With Tachograph Drive

Vehicles equipped with tachographs have cable drive assembly installed in front axle left-hand steering knuckle, as shown in figure 2. A drive clip, riveted to left-hand hub cap, causes tachograph drive shaft to turn as hub rotates. Left-hand hub cap and gasket are not interchangeable with right-hand hub parts. Inner bearing cone and bearing spacer also are not interchangeable.

Procedures for adjusting, removing, and installing front hubs and bearings (with or without tachograph drive) are the same, as shown by comparing figures 1 and 2.

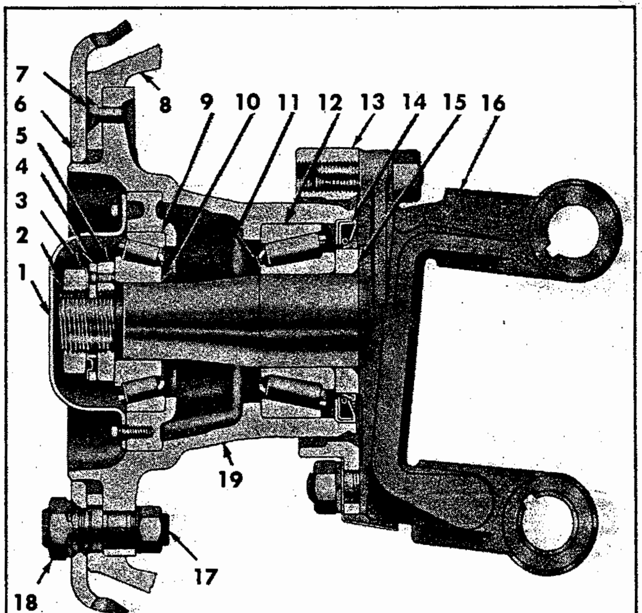
BEARING ADJUSTMENT

Bearing adjustment should be checked at each inspection period. Jack up vehicle as instructed under "Jacking Up Vehicle" in "WHEELS AND TIRES." When vehicle has been jacked up, place a pry bar under tire of wheels to be checked, then observe movement of brake drum in relation to brake spider or shoes. If bearings are adjusted correctly, movement of brake drum will be just noticeable and wheels will turn freely with no drag. If tests indicate that adjustment of bearings is necessary, use the procedures outlined below.

FRONT WHEEL BEARINGS

Key numbers in text refer to figure 1 or 2.

1. Remove six cap screws and lock washers which attach hub cap (1) to hub (19), then remove hub cap and gasket.
2. Raise lip of nut lock (3) and remove lock nut (2), nut lock (3), and lock ring (4) from steering knuckle spindle.
3. Tighten wheel bearing adjusting nut (5) until wheel binds, at the same time rotating wheel to make sure all surfaces are in proper contact.
4. Back off bearing adjusting nut (5) 1/6 turn, or more if necessary, making sure wheel turns freely.
5. Position lock ring (4) on spindle, with dowel pin in adjusting nut (5) inserted in hole of lock ring



1 Hub Cap	10 Outer Bearing Cone and Roller Assy.
2 Lock Nut	11 Inner Bearing Cone and Roller Assy.
3 Nut Lock	12 Inner Bearing Cup
4 Adjusting Nut Lock Ring	13 Brake Spider
5 Bearing Adjusting Nut	14 Oil Seal
6 Wheel	15 Bearing Spacer
7 Brake Drum Retaining Screw	16 Steering Knuckle
8 Brake Drum	17 Wheel Stud
9 Outer Bearing Cup	18 Wheel Nut
	19 Hub

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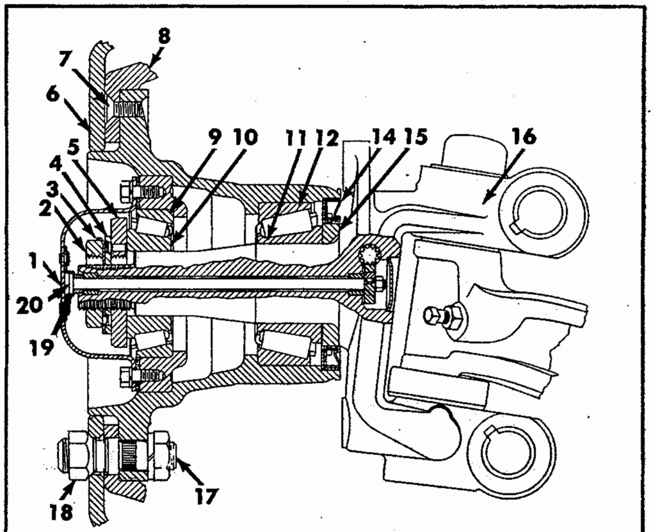
Figure 1—Standard Front Hub, Bearings, and Oil Seal



1 Hub Cap	10 Outer Bearing Cone and Roller Assy.
2 Lock Nut	11 Inner Bearing Cone and Roller Assy.
3 Nut Lock	12 Inner Bearing Cup
4 Adjusting Nut Lock Ring	14 Oil Seal
5 Bearing Adjusting Nut	15 Bearing Spacer
6 Wheel	16 Steering Knuckle
7 Brake Drum Retaining Screw	17 Wheel Stud
8 Brake Drum	18 Wheel Nut
9 Outer Bearing Cup	19 Drive Clip
TPM-5466	20 Drive Shaft End

Figure 2—Front Left Hub with Tachograph Drive

(4). Either side of ring may be used toward adjusting nut. When installing lock ring (4), place first one side then other side toward adjusting nut (5), to determine which position will permit dowel pin in nut, to line up with hole in lock ring (4) with least change in position of adjusting nut (5).

6. Install nut lock (3) and lock nut (2) on steering knuckle spindle. Draw lock nut up tight.

7. Recheck wheel bearing adjustment; then bend lip of nut lock (3) down against flat of lock nut (2).

8. Install hub cap (1) and new gasket on hub, attaching with six cap screws and lock washers.

NOTE: When installing tachograph drive hub cap and gasket, engage drive shaft end (20) in drive clip (19) on hub cap. (Refer to figure 2.)

REAR WHEEL BEARINGS

Key numbers in text refer to figure 3.

1. Remove axle shaft as directed in REAR AXLE (SEC. 2) of this manual.

2. Remove gaskets (4) and wheel bearing outer oil seal (3) from axle shaft flange studs.

3. Remove wheel bearing outer oil seal wiper and cork assembly (1) from end of axle housing tube.

4. Unscrew lock nut (5) and remove adjusting nut lock ring (6) from axle housing tube.

5. Tighten wheel bearing adjusting nut (7) until wheel binds, at the same time turning wheel to make sure all surfaces are in proper contact.

6. Back off adjusting nut (7) about 1/6 turn, or more if necessary to make sure wheel turns freely.

7. Position lock ring (6), with dowel pin in adjusting nut (7) inserted in hole of lock ring (6). Either side of ring may be used toward adjusting nut. When installing lock ring (6), place first one side then other side of ring toward adjusting nut (7), to determine which position will permit dowel pin in nut, to line up with hole in lock ring with least change in position of adjusting nut.

8. Install lock nut (5) and tighten firmly; then recheck bearing adjustment.

9. Press oil seal wiper and cork assembly (1) on end of axle housing tube.

10. Place new inner gasket (40 on hub over axle shaft flange studs.

11. Coat lip of outer oil seal (3) and oil seal wiper (1) with grease; then install oil seal (3) with holes in retainer over axle shaft flange studs. If oil seal is damaged or worn, even slightly, use a new oil seal.

12. Position new outer gasket (4) on hub (10) over axle shaft flange studs.

13. Install axle shaft as directed in REAR AXLE (SEC. 2) of this manual.

OIL SEALS

Front and rear hubs, have oil seals at inner end to prevent leakage of wheel bearing lubricant from hubs into brake drums. Inner oil seals also prevent water and dirt from entering hubs and contaminating wheel bearing lubricant. Oil seals at outer ends of rear hubs prevent rear axle differential lubricant, from entering hubs and mixing with wheel bearing lubricant.

Inner seals used in both front and rear hubs are rotating, spring-loaded type. Front seals are pressed into inner end of hub and seal lip wipes on bearing spacer (fig. 1). Rear hub inner seals are pressed into seal retainers which are attached to inner end of hubs with screws; seal lip wipes on a wiper sleeve which is pressed on axle housing tube (fig. 3).

Outer seals used in rear hubs are spring-loaded lip-type seals with integral retainers which fit over axle shaft drive plate studs. Lip of oil seal wipes on oil seal wiper which is pressed onto outer end of axle housing tube. Wiper to tube cork gasket is cemented to inner side of wiper.

At regular inspection periods, examine all seals carefully. If there is the slightest indication of wear, deterioration, or damage at sealing surface, a complete new seal assembly should be in-

stalled. Examine surface of oil seal wiper, wiper sleeve, or bearing spacer against which seals rear. Any nicks, scratches, or rough spots on these surfaces will impair efficiency of seals.

Always spread a thin coating of grease on face of oil seal, oil seal wiper, wiper sleeve, or bearing spacer before installing parts in hub.

FRONT HUB AND BEARING REMOVAL

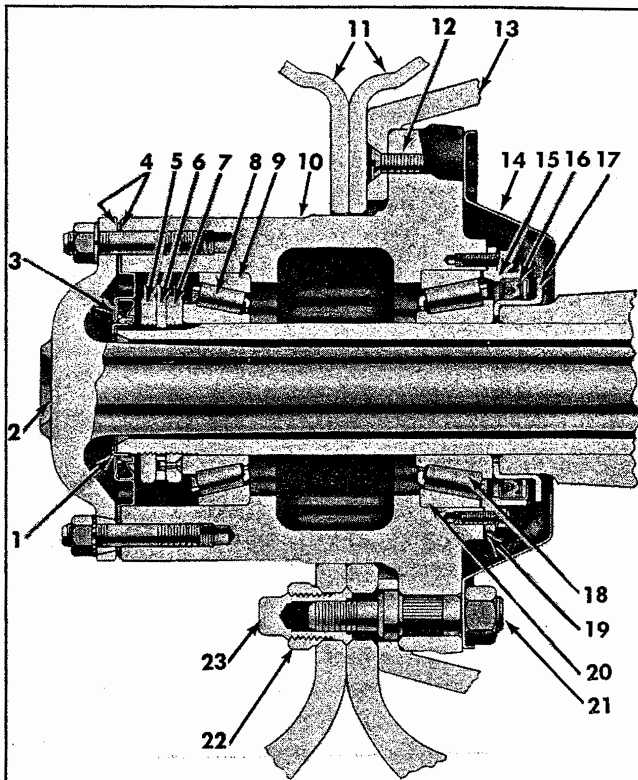
Key numbers in text refer to figure 1.

1. Jack up front of vehicle as instructed in "WHEELS AND TIRES" section.
2. Remove ten wheel stud nuts; then remove wheel and tire.
3. Remove five brake drum to hub retaining screws (7), then remove brake drum (8).
4. Remove six cap screws and lock washers; then remove hub cap (1) and gasket.
5. Raise lip of nut lock (3) and remove lock nut (2), nut lock (3), lock ring (4), and bearing adjusting nut (5) from steering knuckle spindle.
6. Pull hub assembly (19) straight off spindle, being careful not to permit outer bearing (10) to fall out of hub (19).
7. Remove outer bearing cone and roller assembly (10) from hub (19).
8. Pull inner oil seal (14) and washer out of hub (19); then lift inner bearing cone and roller assembly (11) out of hub (19).
9. Perform cleaning and inspection operations outlined under "Cleaning and Inspection" later in this section. If inspection indicates need for replacing bearing cups (9 or 12), they may be driven out of hub (19), using a long brass drift and hammer through opposite end of hub (19).
10. If necessary to remove bearing spacer (15), drive a chisel between inner edge of spacer and steering knuckle (16) to force spacer out far enough to permit use of a puller. Be extremely careful not to mar or damage steering knuckle spindle with chisel.

REAR HUB AND BEARING REMOVAL

Key numbers in text refer to figure 3.

1. Jack up vehicle as instructed in "WHEELS AND TIRES" section.
2. Remove 10 outer wheel nuts (22) and 10 inner wheel nuts (23), then remove wheels and tires.
3. Remove five brake drum to hub retaining screws (12); then remove brake drum (13) from hub (10).
4. Remove axle shaft (2) as directed in REAR AXLE (SEC. 2) of this manual.
5. Remove wheel bearing outer oil seal (3) and gaskets (4) from axle shaft flange studs.
6. Remove wheel bearing outer oil seal wiper and cork assembly (1) from end of axle housing tube.
7. Remove lock nut (5), lock ring (6), and adjusting nut (7) from axle housing tube.
8. Lift hub (10) off axle housing tube, holding hand over outer end of hub to prevent outer bearing (8) from falling out. Remove outer bearing cone and roller assembly (8) from hub.
9. Remove six screws attaching inner oil seal retainer (15) to hub (10); then remove inner oil seal (16) and retainer (15) and gasket (19) from hub (10).
10. If desired inner oil seal (16) can be push-



1	Oil Seal Wiper and Cork Assembly	13	Brake Drum
2	Axle Shaft	14	Oil Slinger
3	Outer Oil Seal Assembly	15	Inner Oil Seal Retainer
4	Gaskets	16	Inner Oil Seal
5	Lock Nut	17	Inner Oil Seal Wiper
6	Lock Ring	18	Inner Bearing Cone and Roller Assembly
7	Adjusting Nut	19	Gasket
8	Outer Bearing Cone and Roller Assembly	20	Inner Bearing Cup
9	Outer Bearing Cup	21	Wheel Stud
10	Hub	22	Outer Wheel Nut
11	Wheels	23	Inner Wheel Nut
12	Brake Drum Retaining Screw		

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Figure 3—Rear Hub, Bearings, and Oil Seal

ed out of seal retainer (15).

11. Lift inner bearing cone and roller assembly (18) out of hub (10).

12. If necessary to remove oil seal wiper sleeve (17), as indicated under "Cleaning and Inspection" following, use chisel or suitable tool and drive sleeve off axle housing. Be careful not to damage axle housing tube.

13. If necessary to remove bearing cups (9 and 20) from hub (10) as indicated under "Cleaning and Inspection" following, they may be driven out of hub by using a hammer and long brass drift through opposite end of hub.

CLEANING AND INSPECTION

CLEANING

1. Immerse bearing cone and roller assemblies in gasoline or other suitable cleaning solvent. Clean bearings with a stiff brush to remove old lubricant. Blow bearings dry with compressed air, directing air stream at right angles to bearing. DO NOT SPIN BEARINGS WITH AIR PRESSURE.

2. Thoroughly clean all old lubricant out of inside of hub and wipe hub dry. Make sure all particles of old gasket are removed from inner end of hub.

3. Clean all lubricant off rear axle housing tube or front axle spindle. Wipe lubricant off oil seals, using a clean cloth dampened with cleaning solvent. Do not permit cleaning solvent or grease to get on brake linings.

4. Wash all small parts such as bearing nuts, lock rings, and oil seal wipers in cleaning solvent. Wipe parts dry.

INSPECTION

1. Inspect bearing rollers for excessive wear, chipped edges, or other damage. Slowly rotate rollers around cone to detect any flat or rough spots on cone or rollers. Do not mistake dirt or grit for roughness. Replace bearing assemblies if any damage is found.

2. Examine bearing cups in hub. If cups are pitted or cracked, they must be replaced with new parts.

3. Carefully examine oil seals for signs of wear, deterioration, distortion, or damage at the sealing surfaces. Replace oil seal assembly if any of the above conditins are evident.

4. Inspect oil seal wiper, wiper sleeve, or bearing spacer for nicks or rough spots which would cause rapid wear of oil seals. Replace with new parts as necessary.

5. After inspection is completed and parts replaced as deemed necessary, lubricate bearings and inside of hub as directed in LUBRICATION (SEC. 13).

FRONT HUB AND BEARING INSTALLATION

Key numbers in text refer to figure 1.

1. Install bearing spacer (15) (if removed), driving on steering knuckle spindle. Make sure spacer is fully seated against knuckle flange.

2. If inner and outer bearing cups (9 and 12) were removed from hub (19), drive or press new cups into hub with wide side of cups toward inside of hub. Make sure cups are fully seated against shoulder in hub and not cocked.

3. Make sure inner and outer bearings (10 and 11) and inside of hub (19) are lubricated as directed in LUBRICATION (SEC. 13).

4. Place inner bearing cone and roller assembly (11) inside hub (19).

5. Position oil seal washer in hub (19); then press oil seal (14) into hub until flush with inner end of hub. Lip of oil seal must point toward inside of hub.

6. Coat face of inner oil seal (14) and bearing spacer (15) with grease.

7. Install hub assembly (19) on front axle spindle being careful not to damage oil seal (14).

8. Place outer bearing cone and roller assembly (10) on spindle. Push bearing into hub with fingers.

9. Install bearing adjusting nut (5) on spindle and tighten against outer bearing (10) finger-tight.

10. Position brake drum (8) on flange of hub (19) and attach with five retaining screws (7).

11. Position wheel and tire on hub (19); then attach with ten stud nuts.

12. Adjust front wheel bearings; then complete installation as previously directed under "Bearing Adjustment" earlier in this section.

REAR HUB AND BEARING INSTALLATION

Key numbers in text refer to figure 3.

1. If inner oil seal wiper (17) was removed from axle housing, reinstall wiper sleeve on housing.

2. If inner and outer bearing cups (9 and 20) were removed from hub (10), drive or press new cups into hub with wide side of cups toward inside of hub. Make sure cups are fully seated against shoulder in hub and not cocked.

3. Lubricate bearings and inside of hub as directed in LUBRICATION (SEC. 13).

4. If inner oil seal (16) was removed from seal retainer (15), press new oil seal into retainer. Use extreme care when pressing oil seal into place not to distort seal flange.

5. Place inner bearing cone and roller assembly (18) inside hub (10); then position inner oil seal (16) and retainer (15) on inner end of hub (10), using

new gasket (19) between retainer and hub.

6. Attach retainer (15) to hub (10) with six screws and lock washers. Tighten screws up evenly and firmly.

7. Coat face of oil seal (16) and oil seal wiper (17) with grease.

8. Position hub assembly (10) on axle housing tube, being careful not to damage inner oil seal (16).

9. Place outer bearing cone and roller assembly (8) on axle housing tube. Push bearing into hub with fingers.

10. Install bearing adjusting nut (7) on axle housing tube. Tighten adjusting nut against outer bearing finger-tight.

11. Position brake drum (12) on flange of hub (10) and attach with five retaining screws.

12. Install wheels and tires on hub and attach with twenty wheel stud nuts.

13. Adjust rear wheel bearings; then complete installation as previously directed under "Bearing Adjustment" in this section.

Wheels and Tires

JACKING UP VEHICLE

Whenever it is necessary to change a tire on the road, certain procedures must be followed.

FRONT

1. At front turn wheels to extreme right or left depending on which tire is flat.

2. Run flat tire up on run-up block (fig. 5) as shown in view A, fig. 4. Fully apply hand brake.

3. Place jack under front axle center as shown in view A, figure 4 and raise vehicle.

4. Remove run-up block and proceed to change tire.

5. Lower jack and remove from under axle center. NOTE: When adjusting bearings or repairing hub and drum, as a safety precaution, wooden blocks should be placed under coach body after vehicle is jacked up.

REAR

1. To change outside dual, place wooden run-up block (fig. 5) at inside tire.

2. Drive vehicle onto block to raise outside dual off ground.

3. Fully apply hand brake, then proceed to change wheel and tire.

4. To change inner dual, fully apply hand brake.

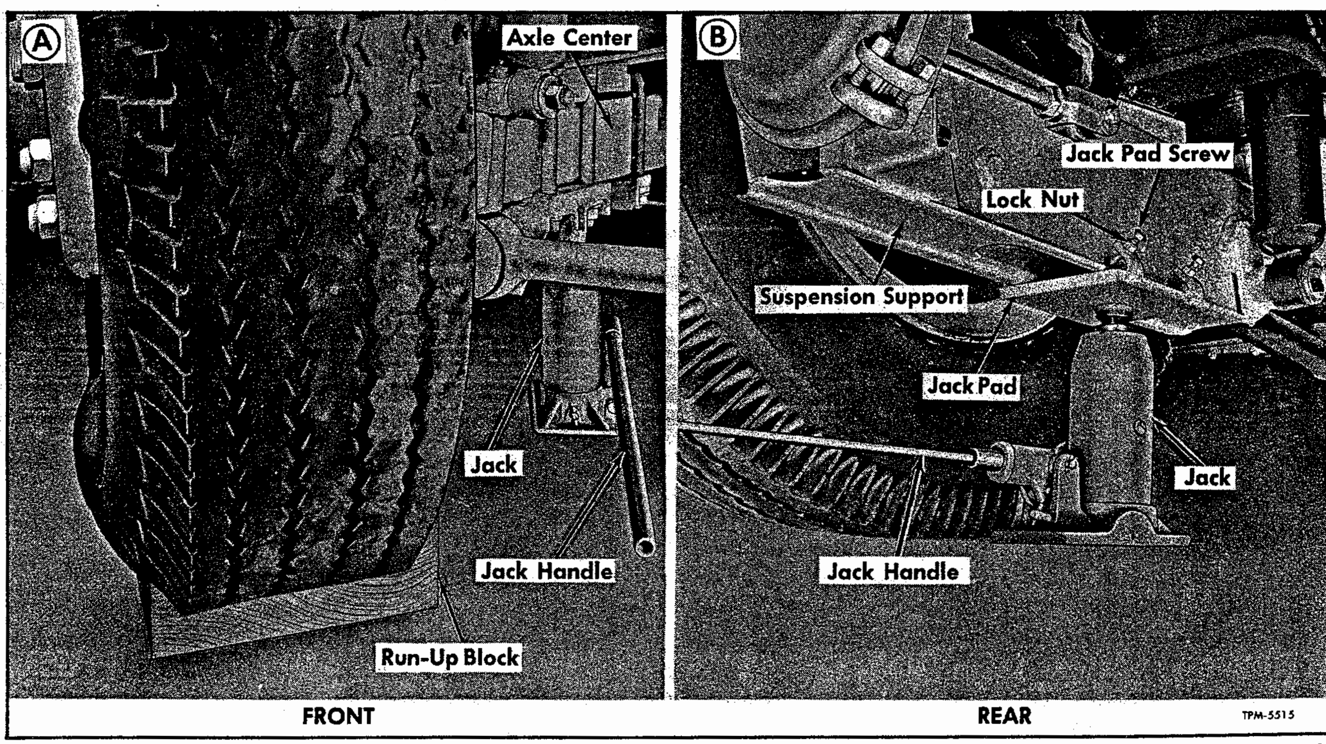

Figure 4—Method of Jacking Up Vehicle

WHEELS AND TIRES

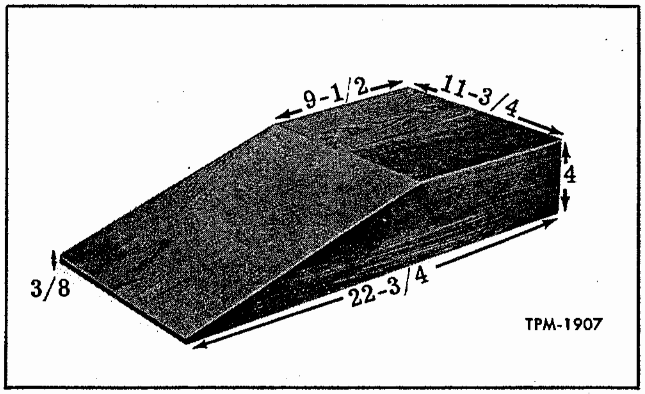

Figure 5—Run-Up Block

5. On vehicles equipped with jack pad, position jack under jack pad as shown in view B, figure 4. Jack up axle and proceed to change wheel and tire.

NOTE: On vehicles not equipped with jack pads use a suitable block between jack and suspension support and apply same procedure as step 5.

6. When adjusting bearings or replacing hub and drums, as a safety precaution, wooden blocks should be placed under vehicle body after vehicle is jacked up.

SPARE TIRE AND COMPARTMENT

Spare tire and wheel is stowed in compartment behind front bumper. Small access door in floor

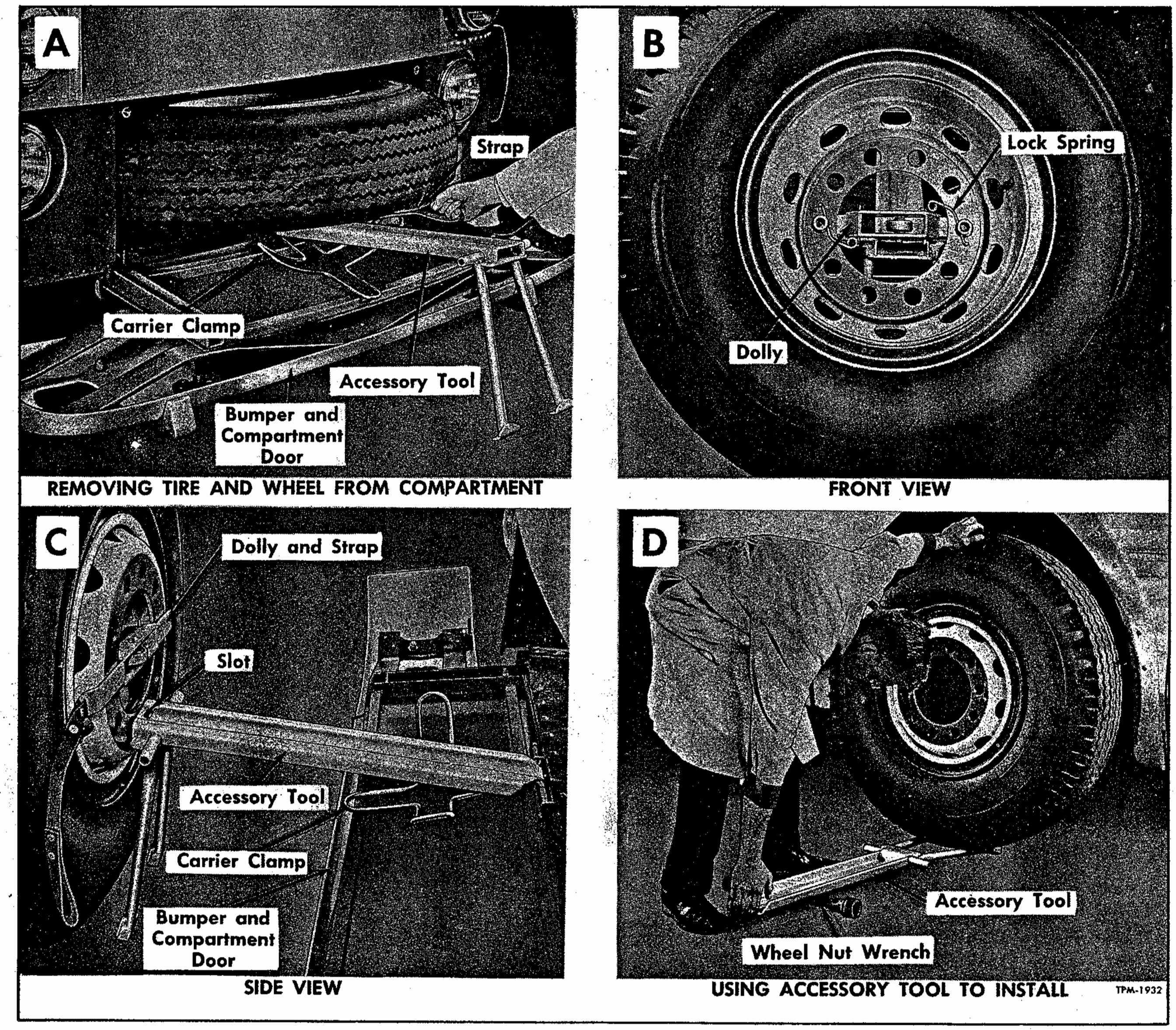

Figure 6—Method of Handling Spare Tire and Wheel

of compartment can be opened to check and inflate spare tire without removing tire and wheel from compartment. NOTE: When tire and wheel is stowed in compartment, make sure that tire valve is toward front of coach so that valve is located near small access door in floor of compartment. Accessory tool (used on some vehicles) is stowed in heating compartment.

REMOVAL FROM COMPARTMENT (When Vehicle is Equipped With Accessory Tool)

1. Open spare tire compartment by inserting wheel wrench through two openings in bumper and unscrew retaining bolts, one each side. Lower front bumper and compartment door.

2. Lower spare tire carrier clamp shown in A, figure 6, then position spare tire accessory tool as shown in C, figure 6.

3. Grasp strap of spare tire dolly (A, figure 6) and pull spare tire with dolly upward and slowly forward until wheel of tire dolly drops into slot in accessory tool (C, fig. 6).

CAUTION: When wheel of dolly approaches slot in accessory tool, use extreme care to prevent wheel from jumping past the slot.

4. Turn tire, wheel, and dolly 1/4 turn and lower tire and wheel to floor as shown in View B, figure 6. Wheel on dolly will engage slot in accessory tool and prevent tire and wheel from slipping off accessory tool and causing injury.

5. Place tire and wheel fully on floor as shown in view C, figure 6, then remove dolly and strap by releasing two lock springs which attach dolly to wheel.

6. Open accessory tool to full length and place wheel nut wrench at lifting end of tool as shown in view D, figure 6, then roll wheel and tire on accessory tool. Lift on end of accessory tool to raise tire and wheel onto hub as shown in view D, figure 6.

INSTALLATION IN COMPARTMENT

1. Position accessory tool as shown in view C, figure 6.

2. Install dolly and strap on wheel by locking two lock springs which attach dolly to wheel as shown in view B, figure 6.

3. Place wheel on accessory tool with dolly in position as shown in view C, figure 6.

4. Turn wheel and tire 1/4 turn so that wheel on dolly will run parallel with accessory tool, then slide wheel, tire, and dolly into compartment as shown in view A, figure 6.

5. Remove accessory tool, then raise tire carrier clamp into proper position. Close front bumper and compartment door and secure with two retaining bolts.

6. Store accessory tool in heating compartment.

WHEEL MAINTENANCE

Wheel studs and nuts on left side of vehicle have left-hand threads. Studs and nuts on right side of vehicle have right-hand threads.

1. Before new vehicle goes into service and after each wheel removal, all wheel stud nuts should be thoroughly tightened. Refer to instructions below for wheel nut torque and wheel nut tightening procedure. See that studs and nuts are free from grease or oil. Do not use oil on studs or nuts.

2. To tighten stud nuts on dual rear wheels, loosen outer nuts, then tighten inner nuts. Tighten opposite nuts alternately so that wheel will be square against hub flange. After tightening inner nuts, tighten outer nuts to specified torque.

3. Re-tighten stud nuts every 100 miles for first 500 miles to offset setting-in of clamping surfaces.

4. Inspect wheel stud nuts at least every 1000 miles thereafter. If vehicle is subjected to severe service, inspection should be made daily regardless of mileage.

5. When changing wheels or tires and before assembling wheels to hubs, remove dirt, grease, and excess paint from the mating surfaces. Dual rear wheels should be positioned with valve stems 180 degrees apart.

WHEEL NUT TORQUE

Excessive tightening of wheel stud nuts has proven to be the cause of erratic brake action in some cases. Where excessive torque is applied, brake drum distortion will occur.

Improper procedure in tightening of wheel stud nuts, including excessive torque, has also been found to cause wheel distortion and wheel runout. Such condition will have decided effect on tire life. Wheel nuts should be carefully torqued so that the following limits are not exceeded - 350 to 400 ft. lbs. These specifications have proven to be entirely satisfactory to insure wheel tightness and torque applied exceeding these limits is not recommended. To insure correct torque, a large size torque wrench should be used. A number of torque wrenches suitable to this application are available, one of which is made by "Snap-On" in a 0 to 600 ft. lb. capacity with a 3/4" drive. "Snap-On" tool number is TA 602A, and is also available with a light indicator under tool number TQ602AL. If a pneumatic impact wrench is used for tightening wheel stud nuts, it should be used only for initial "run-in" of nuts in order to allow wheel to correctly position itself on the hub. Final tightening should be done with a torque wrench to insure that all nuts are torqued evenly and not beyond the limits shown herein.

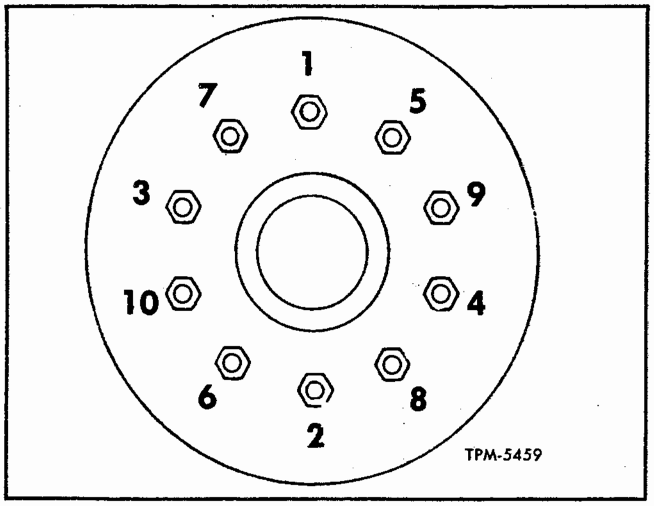

Figure 7—Wheel Nut Tightening Sequence

WHEEL STUD NUT TIGHTENING PROCEDURE

It is important that wheel stud nuts be tightened alternately on opposite sides of wheel. A suggested sequence for tightening is shown in figure 7, and a recommended procedure is as follows:

1. Run the stud nuts in lightly, following the sequence shown, so that wheel will position itself concentrically with hub. THIS IS IMPORTANT; OTHERWISE WHEEL MAY BE ECCENTRIC WITH HUB AND WILL NOT RUN TRUE. In this initial step, run the nuts up only as necessary to correctly position wheel.

2. Tighten nuts progressively, in the sequence shown in figure 7, with torque wrench until torque limit is reached. Do not tighten each nut completely at one time but progress from one nut to another so that wheel is tightened uniformly.

WHEEL INSPECTION

Do not use wheels with bent rims. Continued use of wheels with bent rims will result in excessive tire wear and, if wheel is mounted on front of vehicle, difficulty in steering vehicle will be experienced. Wheels that are thought to be distorted should be checked as follows (see fig. 8):

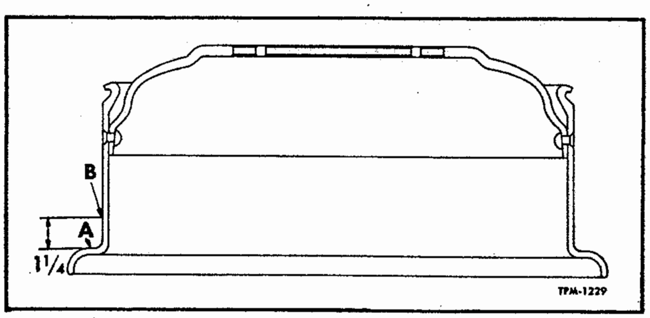

Figure 8—Wheel Checking Diagram

1. Remove wheel from vehicle and dismount tire.
2. Clean all rust, scale, dirt, and grease from rim.
3. Mount wheel securely in lathe or other suitable fixture. NOTE: Face of hub must run true, as any run-out at that point will be increased from 1-1/2 to 3 times at checking points on rim.
4. Revolve wheel slowly and check at point "A" for lateral runout (wobble). This should not exceed 3/32-inch. Check at point "B" for radial run-out (out-of-round). This should not exceed 1/8-inch total indicator reading. Wheels that are distorted in excess of these limits should be replaced.

TIRE MAINTENANCE

Some coaches are equipped with tubeless tires, while others have tube type tires.

One of the most important factors of economical and safe motor vehicle operation is systematic and correct tire maintenance. Tires must not only support weight of loaded vehicle, but they are also integral parts of the transmission and braking systems. Therefore, tires should receive careful, systematic, and regular maintenance as do other operating units. Three major causes of tire trouble are (1) improper-inflation, (2) overloading, and (3) misalignment. Tires should be checked periodically for these conditions.

INFLATION OF TIRES

Improper-inflation is the greatest cause for loss of tire life expectancy. Tires should be checked frequently for this condition. Tire fabric, rubber, bead, contour, and size used on these vehicles are designed to obtain maximum length of service under all operating conditions to which vehicles may be subjected. TIRES ARE DESIGNED TO OPERATE EFFICIENTLY ONLY ON A PRESCRIBED AMOUNT OF AIR. Unless correct air pressure is consistently maintained, tires will not function as they should; consequently, safe, economical operation of vehicle will be materially affected.

Operating air pressure recommended by the tire manufacturer is as essential to safe and economical operation of tire, as proper amount of oil would be to an engine or other chassis units.

An under-inflated tire runs sluggishly, heats up quickly because of greater flexing, and is subjected to more frequent bruising.

Over-inflation does not compensate for overloading. It does not add strength to tire, in fact, it actually weakens the tire by reducing its ability to absorb road shock, and may cause a blow-out.

In addition to the deteriorating effect improperly-inflated tires may have on tire life, improperly-inflated tires will effect steering, riding comfort, and safe driving.

Tires are designed to operate at certain recommended inflations, which provide normal flexing with proper deflection and road contact. If flexing is changed from normal, either by over-inflation, under-inflation, or overloading, proper service from tire cannot be obtained. FOLLOW TIRE PRESSURE RECOMMENDATIONS OF THE TIRE MANUFACTURER.

BALANCED INFLATION

The operating efficiency of vehicle will be seriously upset if air pressures in tires are out of balance. Balanced inflation, may be expressed as, all tires on the same axle should always carry same air pressure. A difference in air pressure of rear tires and front tires may be permissible within certain limitations; however, there should not be a difference in pressures between right and left tires on the same axle. A five pound under-inflation in one front tire not only can destroy ease of steering, but creates steering hazards which generally point to a potential accident. An under-inflated rear tire can destroy the value of the most efficient brakes. Balance tire pressures for ease of steering, comfort in riding, safety in driving, as well as for minimum fuel consumption and maximum tire mileage.

PRESSURE LOSS

At periodic intervals, each tire should be gauged for pressure loss with an accurate gauge before tires are brought to correct operating pressure. Purpose of this check is to determine exact pressure losses in each tire. In other words, if at the time this check is made, a definite pressure loss is noted in any one of the tires, an inspection should be made of tire showing loss and cause of loss corrected. This method should definitely establish a "danger signal" on the condition of tires. Pressure loss check should be made consistently with the same gauge, so that any element of inaccuracy in gauge will be the same for all tires.

ROTATION OF TIRES

Tires should be interchanged at regular intervals to obtain maximum life. Change wheels without dismounting tires so direction of rotation will be reversed. The following system of interchanging is suggested: Right front to left rear inside or right rear outside. Left front to right rear inside or left rear outside.

If inside dual tires show more wear than outside dual tires, place front tires on inside when changing. In this case, outside dual tires can be interchanged between right and left-hand side of vehicle.

If outside dual tires show more wear than inside dual tires, place front tires on outside dual tires when changing. At the same time, interchange right and left-hand inside dual tires.

New tires should be installed on front wheels where they run coolest.

TIRE VALVES

The valve core is a spring-loaded check valve installed in valve stem, permitting inflation, or deflation of the tire. This check valve, or core, is not intended to hold the air during operation. The valve cap is provided to seal air in the tube or tire. When valve cap is tightened down on stem, the sealing washer inside cap is pressed tightly against top of stem, preventing air leakage. Valve cap also prevents dirt and moisture from entering valve stem to injure valve core mechanism. It is important therefore, that valve caps be used.

SELECTION OF TIRES

All tires on the same axle should, whenever possible, be of the same make, since differences in design and tread in some instances result in unequal tire rolling radii. It is not possible to match all tires exactly. Therefore, some tolerance must be permitted. When installing tires on a vehicle, all tires on same axle should have the same outside diameter within tolerance limits. The most desirable matching is obtained by not exceeding 3/4-inch difference in circumference or 1/4-inch difference in diameter. If tires do not have the same outside diameter (within 1/4-inch) excessive tread scuffing and hard steering will result. Tire diameters may be measured with a conventional tire measuring gauge.

TIRE REPLACEMENT

Tube type tires are mounted on flat base wheel rims. Inner tire flanges are integral with wheel rims. Tires are secured on wheel rims by continuous type side rings on some vehicles, while other vehicles use a side ring and locking ring (fig. 9). Tubeless tires are mounted on a one-piece drop-center rim that requires no side ring or locking ring. Instructions which follow cover removal and installation of tube type tires only.

REMOVAL
(Tube Type Tires)

WHEELS WITH SIDE RING ONLY

1. Remove valve cap and valve core to completely deflate tube. Replace valve cap on valve stem to prevent entry of dirt into tube.

2. Loosen tire beads from both rim flanges, using suitable hand tools.

3. Lay wheel on floor with side ring up. Insert tire tool in prying notch of side ring and pry out and up. Use a second tool alongside first tool and pry progressively around ring until side ring is

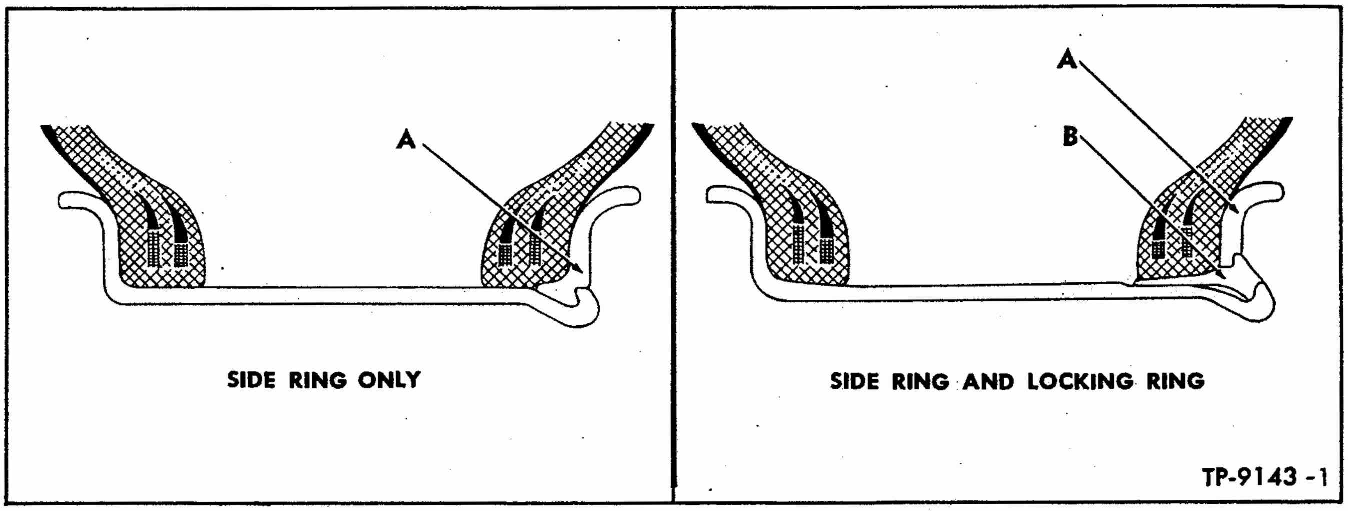

Figure 9—Wheel Rims and Lock Rings

removed from wheel.

4. Force tire valve stem out of slot in wheel and to right or left so it will not catch as tire is removed.

5. Place wheel on blocks ring side down and force tire off wheel. Remove flap and tube from tire casing.

WHEELS WITH SIDE RING AND LOCKING RING

1. Remove valve cap and valve core to completely deflate tube. Replace valve cap on valve stem to prevent entry of dirt into tube.

2. Place tapered end of rim tool in depression of locking ring; then press down on side ring to free tire bead.

3. Continue downward pressure on side ring progressively around tire until tire bead is free from seat.

4. To disengage locking ring from wheel gutter, insert rim tool in removing notch of ring and press downward.

5. Insert a second rim tool alongside first tool with tapered end between locking ring and side ring; then press downward to pry ring up. Move progressively around rim until locking ring is free. Lift off locking and side rings.

6. To loosen other tire bead, turn tire over; then drive flat blade tool between bead and rim flange at any point until tool contacts bead seat of rim.

7. Force down on tool handle and insert rim tool; then pull upward to force tire bead away from rim flange. Continue operation until tire bead is completely loosened.

8. Place wheel on blocks ring side down and force tire off wheel. Remove flap and tube from tire casing.

INSTALLATION
(Tube Type Tires)

IMPORTANT: Most "rim accidents" are caused by carelessness and thoughtlessness when inflating tires after mounting. Such accidents are always serious and sometimes fatal. Be on the safe side - ALWAYS FOLLOW PRECAUTIONS DESCRIBED IN THE FOLLOWING:

On all wheels, the lock ring must be fully seated in rim gutter before inflating tire. This is important for the safety of person inflating tire.

As an added precaution, use a steel bar 1" in diameter and long enough to extend several inches over lock ring at both ends. Bend bar so it can be inserted through wheel spoke openings with both ends of bar extending over lock ring. Leave bar in place until tire is fully inflated. Examine lock ring to see that it is fully seated; then remove safety bar.

WHEELS WITH SIDE RING ONLY

1. Examine inside of tire and remove all dirt or other foreign particles. Make sure surface of wheel where tire is to be mounted is free from rust or dirt.

2. Install tube in tire and inflate just enough to hold it in place in tire; then install flap.

3. Place wheel on block with ring side up; then position assembled tire and tube on wheel with valve stem in slot.

4. Place side of side ring opposite prying notch in wheel rim gutter. Hold other side of ring down with pry tool in notch; then drive side ring into position with rim mallet.

5. Partially inflate tire; then check to make sure side ring is fully seated. Make sure tire beads are properly seated against rim flanges.

6. Inflate tire to correct pressure; then deflate tire to remove wrinkles from tube. Reinflate tire to recommended pressure and install valve cap.

WHEELS WITH SIDE RING AND LOCKING RING

1. Accomplish steps 1, 2, and 3 under "Wheels With Side Ring Only" preceding.

2. Position side ring "A" (fig. 9) on tire bead. Side ring will be automatically centered when locking ring "B" (fig. 9) is in place.

3. Install lock ring by inserting tapered toe of ring between side ring and bottom of tire bead. Hold locking ring with foot at one end of split; then hammer ring into place with rim mallet.

4. Continue hammering progressively around side ring until entire ring is properly seated in rim gutter.

5. Partially inflate tire; then inspect to make sure side ring is fully seated. Make sure tire beads are properly seated against rim flanges.

6. Inflate tire to correct pressure; then deflate tire to remove wrinkles from tube. Reinflate tire to recommended pressure and install valve cap.

WHEEL NUT TORQUE SPECIFICATIONS

Front Wheel Nuts and Rear Wheel Inner and Outer Nuts . . . . 350-400 ft.-lbs.

FOR MAXIMUM TIRE LIFE, FOLLOW THE TIRE PRESSURE RECOMMENDATIONS OF THE TIRE MANUFACTURER.

Air Conditioning

This group includes maintenance and repair information on the Standard GM Air Conditioning System as shown in index below:

NOTE: Some of the air conditioning controls are also used in conjunction with the coach heating system. These controls which are common to both systems are covered in "Heating and Ventilation" (SEC. 3) in this manual.

System Operation

GENERAL DESCRIPTION

The Standard GM Coach Air Conditioning System is designed to provide passenger comfort by cooling, dehumidifying, and filtering the air which is force-circulated within the coach. Briefly, the air conditioning system comprises the following units or systems:

1. The condensing system consists of a four-cylinder gasoline engine and accessories; a three-cylinder reciprocating type refrigerant compressor; a fin and tube type condenser with blade type fan; and a liquid refrigerant receiver. This system is mounted in left side of coach at rear of left front wheelhousing.
2. The cooling unit consists of a fin and tube type evaporator coil and a multi-outlet thermo type expansion valve. These units are mounted in compartment under floor at rear of front axle, and are accessible through the right front baggage compartment.
3. The air circulating system, consisting of air intakes, filter, blower, and air distribution ducts, is the same system as used for the coach heating system described in "HEATING AND VENTILATION" (SEC. 3).
4. Air conditioning controls include the driver's control panel, air conditioning compartment control panel, and several automatic controls which are described later.

REFRIGERANT

The refrigerants used are commonly known by their trade name of Freon-12 (F-12 or Genetron-12 (G-12).

REFRIGERANT CHARACTERISTICS

Refrigerant exists as a gas at atmospheric pressure and must be held under pressure to remain liquid. At ordinary temperatures, it will exist as a liquid under a pressure of about 75 pounds per square inch.

Refrigerant has very little odor, but in large concentrations a faint sweet odor may be detected. It is colorless in both its liquid and gaseous states.

Refrigerant is nonpoisonous, nonflammable, and nonexplosive. It is noncorrosive to any of the ordinary metals.

Goggles should be worn whenever there is the slightest possibility of refrigerant coming in contact with the face or eyes, because refrigerant evaporates and cools so rapidly it will cause an injury similar to frostbite.

TREATMENT IN CASE OF INJURY

Should liquid refrigerant come in contact with the skin, injury should be treated the same as if skin were frost-bitten or frozen. Should liquid refrigerant get into the eyes, a good eye specialist should be consulted immediately. Avoid rubbing

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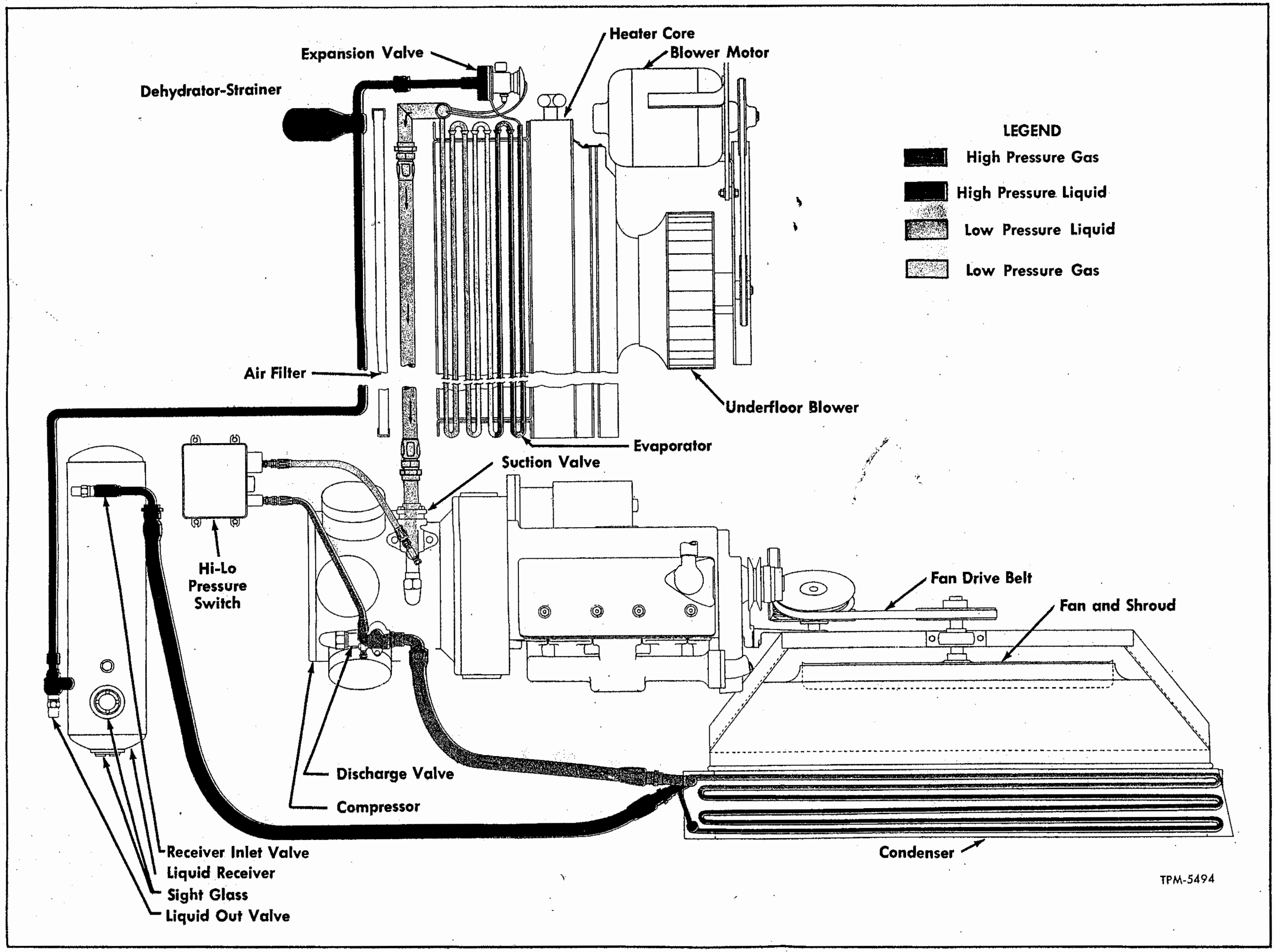


Figure 1—Refrigerant Controls and Lines Showing High and Low Pressures

s. Give the following first aid possible.

erile mineral oil (obtainable at uld be introduced into the eyes. ill absorb the refrigerant. ld then be washed, if irritation ith one of the following:

oric acid solution.
e salt solution not to exceed 2% hloride (table salt).

ition continues for a period longer eyes should be treated for second- ith 10% Argyrol solution or with 1% le ointment.

AIR CIRCULATION

MASTER SWITCH" in "COOLING" po- rfloor blower runs continuously at high wer draws outside air into heating and mpartment through a perforated opening de of coach below forward windows. Re- l air is drawn into the heating and cooling nent through openings in stepwell and a recirculating air inlet under the aisle hion of the second seat from front on both Manually-operated dampers in these inlets remain in open position to admit outside all times when air conditioning system is used.

The outside air and recirculated air are drawn into the air intake chamber, through the underfloor filter, evaporator coil, and heater core and forced into the air distribution chamber.

As the warm air comes in contact with the cold evaporator coils, moisture in the air is condensed and the air is cooled. Condensed moisture runs down to recessed floor under evaporator from where it is discharged under the coach through two drain bowls.

Longitudinal ducts connected to the air distribution chamber carry the dehumidified, cooled air along the floor at each side. Vertical wall ducts between each pair of seats connect to the longitudinal floor ducts. Air from the floor ducts is forced up through the vertical ducts and is discharged into the coach through openings in top of vertical ducts below windows.

The only air exhaust opening provided is through a louvered opening in entrance door. The outside air being pulled into the coach maintains a slight pressure within the coach due to the relatively small size of the air exhaust opening.

Air intake and air distribution system is illustrated in figure 16 in "HEATING AND VENTILATION" (SEC. 3).

REFRIGERANT CIRCULATION

Refrigerant control units and piping is illustrated in figure 1. A complete cycle of the refrigerating system is as follows:

1. Refrigerant in its gaseous state is drawn into the compressor where it is compressed and discharged into the top of the condenser under pressure.
2. As the heated gas circulates through the condenser coils, it is cooled by air being drawn through the condenser by a fan driven from the engine. The combined effects of the decreased temperature and increasing pressure cause the gas to condense (liquify).
3. The liquid refrigerant is then forced from the bottom of the condenser into the liquid receiver.
4. Liquid refrigerant is forced by its own pressure from the liquid receiver through the refrigerant dehydrator-strainer and expansion valve into the evaporator.
5. In the evaporator, where the pressure is reduced, the liquid refrigerant evaporates, or changes into its gaseous state. As the liquid evaporates, heat is absorbed from the air passing through the evaporator coils, thus the air is cooled.
6. Flow of refrigerant into the evaporator is regulated by the expansion valve. The expansion valve is actually a pressure reducing valve which serves two purposes: a - It maintains pressure on the liquid line. b - It admits only the required amount of liquid refrigerant into the evaporator, this requirement being determined by the temperature of the gaseous refrigerant at the evaporator outlet.
7. The low pressure refrigerant gas passes from the evaporator through the suction line to the compressor, thus completing the cycle.

NOTE: Air pressure and vacuum gauges for the checking of pressures in the refrigerant system can usually be obtained from local refrigeration supply dealer.

SYSTEM OPERATION

Some controls and units used with the air conditioning system are common to the coach heating system. These controls and units are: "MASTER SWITCH," heating and cooling underfloor blower and motor, air filter, air intake and distribution ducts, and the Grad-U-Stat, which maintains completely automatic control over the heating system. The heating and cooling systems operate independently of each other, except under certain conditions of cooling system operation when there is an overlapping operation of both systems as explained later. Operation of heating system is explained in

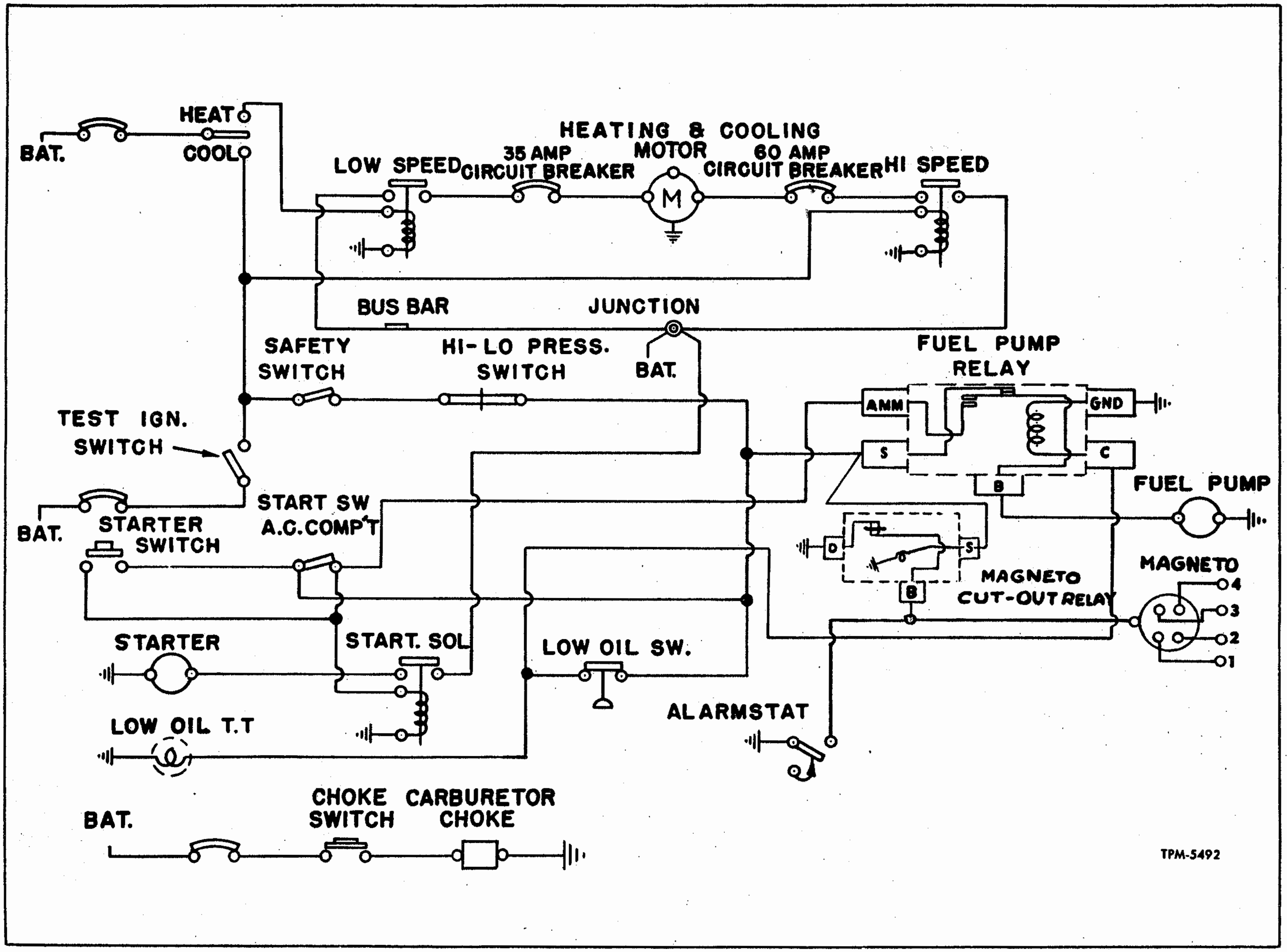


Figure 2—Simplified Schematic Wiring Diagram

'HEATING AND VENTILATION" (SEC. 3).

When "MASTER SWITCH" on driver's control panel is placed in "COOLING" position, two separate circuits are energized -- the underfloor blower high speed circuit and the air conditioning engine control circuit. Except for starting and stopping the engine, operation of air conditioning system is completely automatic. After being started by the operator, the air conditioning engine runs at a constant speed.

When the temperature of the air passing over the Grad-U-Stat is above the Grad-U-Stat setting (75°F.), the bellows expand. Expansion of bellows causes Grad-U-Stat to increase air pressure delivered to the water modulation valve, shutting off flow of hot water through the heater core.

As inside coach temperature cools down, Grad-U-Stat bellows contracts. If coach temperature continues to fall, Grad-U-Stat bellows continues to contract, lowering its delivered pressure to less than 6-1/2 psi. This lowered pressure permits the water modulation valve to open, permitting hot water to flow through the heater core. This reheats the air to prevent further drop in coach temperature.

OPERATION OF SYSTEM CONTROLS

Following is a list of all controls together with a brief description of their function within the system. Detailed descriptions of the operation of major units are included under individual headings in "Maintenance" section later in this group. Refer to schematic wiring diagram (fig. 2) for simplified electrical circuits. Refer to main Wiring Diagram in back of this manual for detailed diagram of electrical circuits and connections.

HEATING-COOLING MASTER SWITCH

Heating-cooling "MASTER SWITCH" on control panel at left of driver is a three position switch with center "OFF" position. With switch lever in "HEATING" position, underfloor blower low speed circuit is energized, causing blower motor to run at low speed for circulation of heated air. With switch lever in "COOLING" position, two circuits are energized. The underfloor blower high speed circuit is energized, causing blower motor to run at high speed for circulation of cooled air, and the air conditioning engine circuit is energized, permitting the operator to start the air conditioning engine.

SAFETY SWITCH

Safety switch on control panel in air conditioning engine compartment has two positions, "SAFETY" and "NORMAL." Purpose of switch is to provide mechanic with a means of preventing the air conditioning engine from being started while working in the compartment. Engine cannot be started with switch in "SAFETY" position. Switch must be in "NORMAL" position to start the engine either from the driver's control panel or from the air conditioning engine compartment control panel. Mechanic should always leave the switch in "NORMAL" position after completing service operations.

STARTER SWITCHES

Starter switch on driver's control panel is a button type switch, spring-loaded in open-circuit position. Starter switch on air conditioning engine compartment control panel is a lever type switch having an "ON" and "OFF" position. Either switch must be held in closed circuit (ON) position and will return to open-circuit (OFF) position when released.

When either switch is closed, starter magnetic switch operating circuit is energized, causing magnetic switch to complete circuit direct from battery to starter. At the same time, starter switches complete circuit through fuel pump relay lower contacts to the electric fuel pump, providing fuel pump operation while engine is being started.

ELECTRIC CHOKE

Electric choke provides the driver with a means of choking engine during cranking. When driver presses "CHOKE" switch on driver's control panel, solenoid in electric choke is energized. Choke lever, connected to solenoid plunger, is attached to carburetor choke valve shaft by an adjustable link. Choke can be operated manually when starting engine at the unit compartment.

FUEL PUMP RELAY

Fuel pump relay is mounted on air conditioning unit compartment front bulkhead. Relay has two sets of contacts; the upper contacts are normally closed and the lower contacts are normally open. Circuit to fuel pump is through the upper contacts when the relay operating coil is de-energized. However, when master switch is placed in "COOLING" position or when test ignition switch is turned "ON" and before the engine is started, the low oil pressure switch contacts are closed. This completes the circuit through the relay coil, pulling the relay armature down, opening the upper contacts and closing the lower contacts. With lower contacts closed, current to fuel pump is supplied from the starter switch as previously explained under "Starter Switches." As soon as engine starts, oil pressure causes low oil pressure switch contacts to open, breaking the circuit to the relay coil. Upper contacts then close and lower contacts open, and circuit to fuel pump is through the upper contacts.

AIR CONDITIONING

MAGNETO CUT-OUT RELAY

Magneto cut-out relay is mounted on air conditioning unit compartment front bulkhead. Relay contacts, which are normally closed, connect the magneto primary circuit to ground. When master switch is placed in "COOLING" position or when test ignition switch is turned "ON," relay coil is energized and contacts are held open. With points open, magneto primary circuit is not grounded, permitting magneto to function. When master switch or test ignition switch is turned off or when hi-lo pressure switch breaks the circuit, cut-out relay coil is de-energized and contacts close, grounding the magneto primary circuit and stopping the engine.

LOW OIL PRESSURE SWITCH

Low oil pressure switch, operated by pressure from the engine main oil gallery, controls circuit to fuel pump relay coil. Tell-tale marked "COOL-LOW OIL" on left switch panel in front of driver illuminates when low oil pressure switch contacts are closed (with master switch in "COOLING" position).

NOTE: Safety switch in engine compartment must be in NORMAL position.

Low oil pressure switch and tell-tale is actually a system which signals the operator that the air conditioning engine has stopped. The engine cannot run with the low oil pressure switch contacts closed due to the interruption of the fuel pump circuit. Any condition which causes the engine to stop, in addition to abnormally low oil pressure, such as overheated engine or out of fuel will cause the "COOL - LOW OIL" tell-tale to illuminate.

Low oil pressure switch contacts, which are normally closed, open when oil pressure reaches 3 psi, + or - 1 psi.

ENGINE ALARMSTAT

Engine alarmstat is installed in engine cylinder head with the thermal unit extending into the water passage in head. This unit is provided to stop the engine when water temperature exceeds a predetermined maximum. Alarmstat contacts, which are normally open, are connected to the magneto primary circuit. When water becomes overheated (230°F.), contacts within switch close, grounding the magneto primary circuit and stopping the engine.

HI-LO PRESSURE SWITCH

Definite high and low refrigerant pressures are established at which the system will operate efficiently and safely. Hi-lo pressure cut-out switch is provided to prevent operation of system when pressures exceed these limits. Switch is mounted on air conditioning unit front bulkhead above compressor, and is connected to high and low refrigerant pressures at the compressor discharge and suction valves. Current from master switch and from test ignition switch is routed through the hi-lo pressure switch. Whenever the high or low refrigerant pressure exceeds limits, switch interrupts engine control circuit and stops engine. When refrigerant pressures normalize to the switch cut-in point, engine control circuit is again completed and the engine may be started.

TEST IGNITION SWITCH

Switch marked "TEST IGN." on control panel in air conditioning unit compartment is a lever type switch with "ON" and "OFF" positions. Switch serves the same purpose as the operator's "MASTER SWITCH," providing the mechanic with a means of operating the system from the unit compartment with the "MASTER SWITCH" in "OFF" position. Whenever switch is in "ON" position, circuit is completed to blower motor high speed switch causing blower to operate at high speed. Bracket on compartment door pushes "TEST IGN." switch and "COMP'T LAMP" switch to "OFF" position when door is closed.

CIRCUIT BREAKERS

Three 20-amp automatic reset type circuit breakers, mounted below control panel at left of driver, protect air conditioning system electrical circuits as follows: No. 7 protects test ignition switch circuit; No. 8 protects electric choke circuit; and No. 18 protects the master switch circuit.

Two automatic reset type circuit breakers, mounted in right front baggage compartment, protect the underfloor blower motor circuits. Circuit breaker protecting the motor low speed circuit (heating) is 35-amp; circuit breaker protecting the motor high speed circuit (cooling) is 60-amp.

Operating Instructions

DRIVER'S OPERATING INSTRUCTIONS

Except for placing "MASTER SWITCH" in "COOLING" position and starting the engine, operation of the air conditioning system is completely automatic. However, the following precautions should be observed:

GENERAL INFORMATION

1. Keep windows closed when operating air conditioning systems. Do not leave door open for excessive periods. Outside air intake dampers must remain open as previously explained under "Air Circulation" in "SYSTEM OPERATION."

2. "COOL-LOW OIL" telltale on left switch

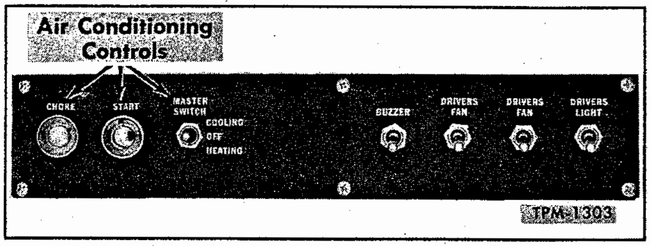


Figure 3—Driver's Control Panel

panel in front of driver will illuminate when "MASTER SWITCH" (fig. 3) is placed in "COOLING" position and will remain illuminated until engine is started.

3. If "COOL-LOW OIL" tell-tale illuminates during operation, it is an indication that the air conditioning engine has stopped. Turn "MASTER SWITCH" to "OFF" position. Engine may have stopped due to one of the following: Out of gasoline, engine overheated, low oil pressure, or short circuit. Cause of engine stopping should be located and corrected before attempting to restart engine.

4. If engine stops and tell-tale does not illuminate, tell-tale bulb is burned out, excessively high or low refrigerant pressure exists, or an open circuit exists. Turn "MASTER SWITCH" to "OFF" position and report condition.

STARTING ENGINE

1. Place "MASTER SWITCH" in "COOLING" position.

2. Press air conditioning engine "START" button; also press "CHOKE" button if engine is cold. Do not hold "START" button in for over 10 to 15 seconds at a time. Release button as soon as engine starts.

3. If engine fails to start, make sure safety switch in unit compartment is in "NORMAL" position. If engine fails to start after reasonable attempts, turn "MASTER SWITCH" to "OFF" position and report condition.

OPERATING SYSTEM FROM AIR CONDITIONING COMPARTMENT

Control panel in air conditioning unit compartment (fig. 4) is provided for use of mechanic when testing and servicing the air conditioning system. System may be operated by these controls without requiring the use of the "MASTER SWITCH" on driver's control panel. Windows and door should be kept closed to obtain normal operation of system and controls.

IMPORTANT: When operating the system for accomplishing service operations, connect a combination air pressure and vacuum gauge to tee fitting at compressor suction valve. To connect

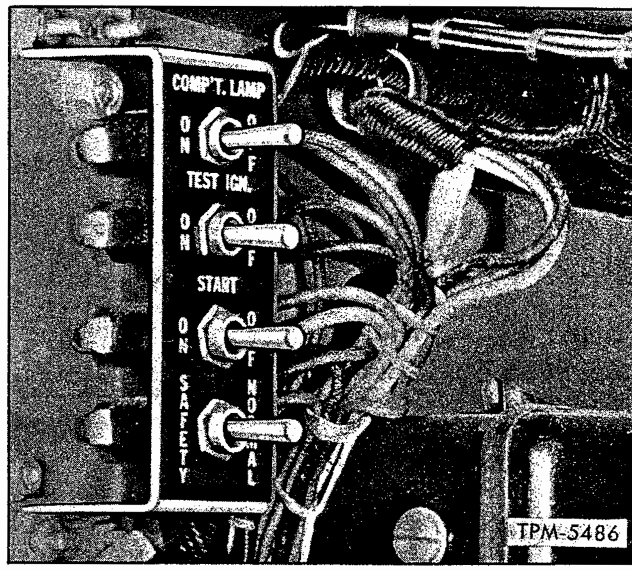


Figure 4—Control Panel in Air Conditioning Compartment

gauge, backseat the suction valve, remove cap from tee, connect gauge to tee, then crack suction valve 1/2 to 1 turn off the backseated position.

1. "SAFETY" switch at bottom of panel must be in "NORMAL" position.

2. Place "TEST IGN." switch in "ON" position. This energizes underfloor blower high speed circuit and air conditioning engine control circuit.

3. Hold "START" switch in "ON" position until engine starts; if engine is cold, press down on lever extending from electric choke housing to choke engine.

4. To run engine at idle for tune-up service, disconnect carburetor throttle rod from governor lever.

5. When service operations are completed, safety switch must be left in "NORMAL" position, otherwise the system cannot be operated from the driver's control panel.

FUEL SYSTEM

Air conditioning engine fuel tank is mounted at center of vehicle under floor at rear of front axle. Fuel tank filler neck is accessible through access door at rear of right front wheelhouse. Tank is equipped with a signaling device which emits a whistle while tank is being filled. Observe label on under side of access door: "GASOLINE - FILL ONLY WHILE WHISTLE BLOWS." An anti-spill valve is also provided to prevent loss of gasoline in the event the vehicle is upset. Fuel tank capacity is 24-1/2 gallons. Drain plug is provided in bottom of tank.

Use gasoline having the least possible lead content to minimize lead deposits in combustion

chambers and exhaust system. The higher the lead content the more frequently must these deposits be removed. If it is possible to obtain non-leaded gasoline, it should be used.

One-half pint of S.A.E. 10 engine oil should be added to each 12 gallons of gasoline to prevent accumulation of deposits in intake manifold. Quantity and viscosity of oil used are important.

ENGINE OIL

For maximum protection of air conditioning engine, it is recommended that only HEAVY DUTY OILS meeting Specification MIL-O-2104, designated as Type A in list published by ICEI (Internal Combustion Engine Institute), be used. Oil having an S.A.E. 30 viscosity should be used.

Crankcase capacity is 3-1/2 quarts, plus one-half quart for oil filter, making a total refill capacity of 4 quarts. Oil level dipstick is at side of oil filler cap. Oil level should be maintained to level of upper mark on dipstick.

Crankcase should be drained and refilled, oil filter cartridge replaced, and air cleaner serviced at 50 hour intervals. Crankcase should be drained immediately after engine has been running while oil is hot. Refer to "POWER PLANT MAINTENANCE" section later in this group for oil filter and air cleaner service instructions.

ENGINE WATER

Air conditioning engine radiator is installed in air conditioning unit compartment behind the condenser coil and blower. Drain cock is provided in end of outlet fitting at bottom of radiator. Cooling system obtains its coolant directly from the coach heater supply line. Refer to figure 16 in "HEATING AND VENTILATION" (SEC. 3) which shows coolant circuit. The air conditioning cooling system can be isolated from the heating system by closing two shut-off valves in air conditioning compartment. This will allow draining the AC cooling system without interfering with the heating system.

IMPORTANT: AC engine must not be operated while valves are closed, regardless as to whether system does or does not contain coolant.

Cooling system capacity is approximately 11 quarts. Refer to "HEATING AND VENTILATION" (SEC. 3) for instructions on draining, filling and bleeding of air conditioning cooling system.

DRIVER'S TROUBLE SHOOTING

It is not the purpose of the following brief trouble diagnosis to enable the driver to completely service the air conditioning system. However, in case of trouble on the road, the driver may accomplish some minor operations which will put the system back in operation, or at least hold to a minimum the amount of service required when vehicle reaches the garage.

ENGINE FAILS TO START

If engine fails to start, first make sure safety switch in air conditioning unit compartment is in "NORMAL" position (fig. 4).

If engine is cold and fails to start, check operation of electric choke. Open air conditioning engine compartment door and attempt to start engine while holding the choke lever down manually. If engine still fails to start, place safety switch in "SAFETY" position. Leave "MASTER SWITCH" in "COOLING" position to run underfloor blower at high speed for ventilation.

ENGINE STOPS AND "LOW OIL" TELL-TALE ILLUMINATES

Whenever the "COOL - LOW OIL" tell-tale illuminates, it is an indication that the air conditioning engine has stopped. Cause of engine stopping may be any one of the following: Low oil pressure, overheated engine, or out of gas. Check for above conditions and correct as necessary. If engine fails to start after checking and correcting the above causes, a short circuit is indicated. Turn master switch to "OFF" position and report condition.

ENGINE STOPS AND "LOW OIL" TELL-TALE DOES NOT ILLUMINATE

If air conditioning engine stops and "LOW-OIL" tell-tale does not illuminate, excessive high or low refrigerant pressure is probably the cause, providing the tell-tale bulb is not burned out. Leave unit shut down for a few minutes, then try to start engine. If engine starts, high or low refrigerant pressure was probably the cause of stopping. High pressure may be caused by condenser being clogged with dirt or road film, or by condenser fan belt being broken or off pulleys. Make sure belt is in good condition and in place, and make sure passages through condenser coil and engine radiator are open. If unit stops repeatedly, report condition.

System Maintenance

The following includes a brief description of the internal operation of the major units, together with adjustment and light maintenance instructions.

COMPRESSOR

The refrigerant compressor (fig. 5) is a three-cylinder reciprocating type unit. It is self-lubricated and self-contained. The shaft seal is rotary type, consisting of a stationary lapped seal face ring pressed into the seal cover plate, with a spring-loaded rotating carbon nose ring working against the seal face of the stationary ring. A Neoprene seal ring between the carbon nose ring and spring acts as a seal around the shaft. The seal faces are flood-oiled under pressure at all times. A sight glass on the side of the compressor shows the oil level. Shut-off valves are provided at the compressor suction and discharge ports.

Compressor can be removed separately from the coach compartment or it can be removed with the engine as a unit. These removal procedures are explained later under "System Tests and Services." Overhaul instructions of compressor are also explained later under "Compressor Overhaul."

COMPRESSOR OPERATION (Fig. 5)

Compressor is bolted to the engine flywheel housing and is driven by a four-pin coupling. Pins in coupling hub engage rubber bushed holes in engine flywheel. The body of the compressor is divided into three main sections -- the discharge or high pressure gas cavity, the suction or low pressure gas cavity, and the crankcase.

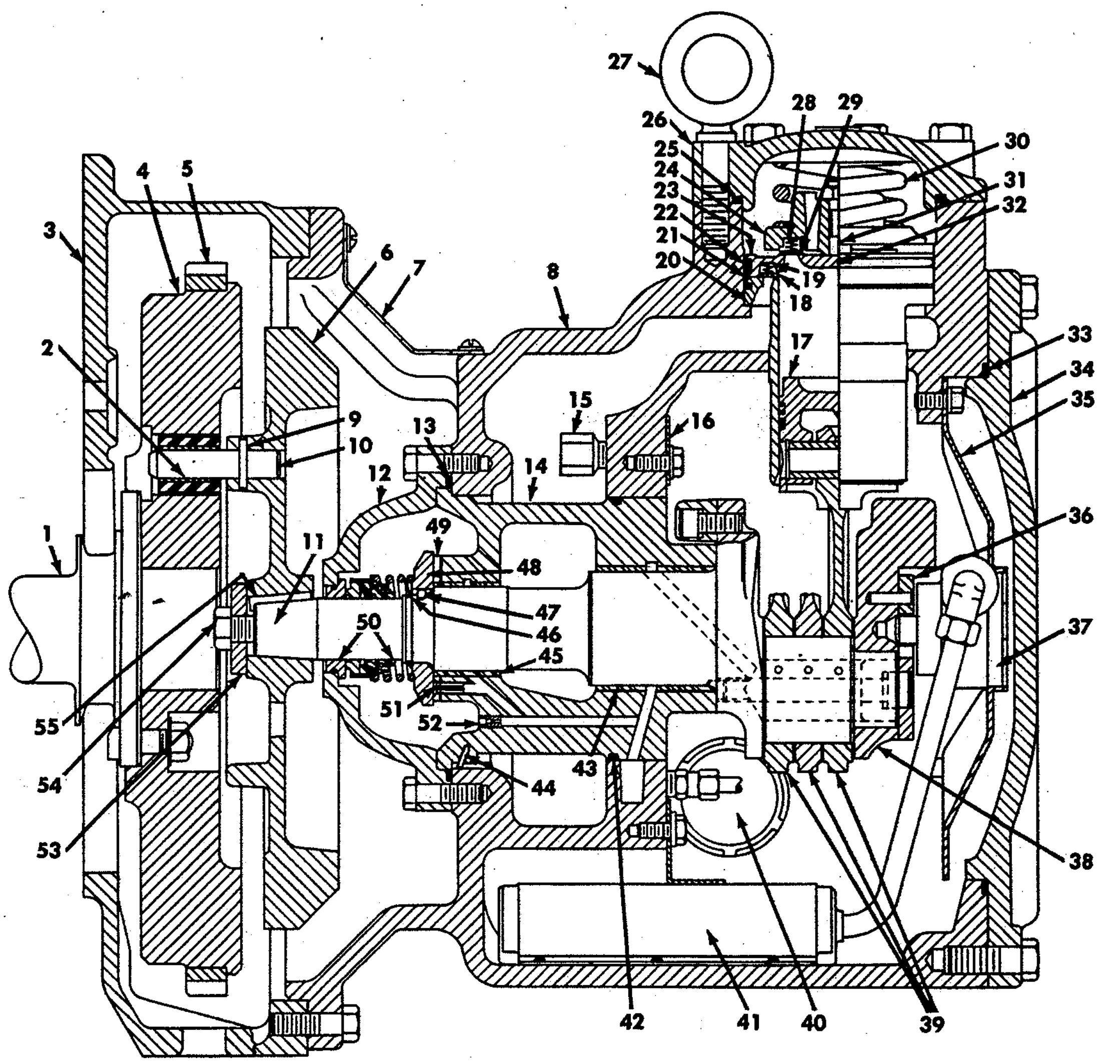
Low pressure refrigerant gas is drawn into the compressor from the suction line. As the refrigerant gas enters the compressor it passes through a fine mesh strainer screen and then into the suction cavity. In the suction cavity, oil entrained with the refrigerant separates from the refrigerant and passes into the crankcase through a check valve. The low pressure refrigerant is drawn into the cylinder during the down-stroke of the piston through the cylinder suction valve which is mounted on the top of the cylinder liner. During the suction stroke of the piston, the cylinder discharge valve in cage on top of cylinder liner is closed. As the piston begins its compression stroke, the cylinder suction valve closes and compression begins. As the piston moves up on the compression stroke, the cylinder discharge valve opens, and the high pressure refrigerant gas passes through the valve into the discharge cavity. The gas then passes through the discharge cavity to the high pressure refrigerant line. A spring-loaded safety relief valve is mounted in the wall which divides the high and low sides of the compressor. This valve serves to relieve or bypass discharge pressure to the low side of the compressor should the discharge pressure build up abnormally high or above the set point of the high to low relief valve. Such a condition would occur if the compressor was operated with the discharge line shut-off valve closed.

COMPRESSOR LUBRICATION (Fig. 5)

The compressor crankcase serves as a reservoir for the main oil charge. A portion of the lubricating oil circulates with the refrigerant, and this oil is separated from the refrigerant as the refrigerant passes through the suction cavity of the compressor. As the low pressure refrigerant and oil separate in the suction chamber, the oil goes to the bottom of the chamber, and the gas goes to the top of the chamber. The oil passes from the suction chamber to the crankcase through a check valve (15, fig. 5) in the crankcase wall. This check valve allows oil to flow into the crankcase from the suction cavity, but checks against the flow of oil out of the crankcase.

During the "OFF" cycle of the compressor, refrigerant tends to collect and condense in the crankcase. The liquid refrigerant mixes with the oil in the crankcase. When the compressor begins to operate, there is a rapid reduction of pressure in the crankcase above the oil level. This permits the liquid refrigerant to evaporate out of the oil. As the refrigerant boils off and leaves the crankcase, the oil tends to foam and leave with the refrigerant. To prevent serious loss of crankcase oil on start-up, the refrigerant leaving the crankcase passes through a fine bronze screen or foam breaker. The foam breaker separates the oil from the refrigerant and returns the oil through a passage to the crankcase.

Compressor lubrication is accomplished by a force feed, direct drive, positive displacement pump, which is mounted in a bracket at the end of the crankshaft (35, fig. 5). The pump is not self-reversing and must be operated in one direction of rotation. Oil from the crankcase is drawn into the pump through a tube which connects the pump to a fine mesh strainer located in the sump of the crankcase. This strainer scavenges oil from the bottom of the crankcase and prevents the entrance of foreign particles into the oil circulating system. The pump forces oil through the discharge tube and into a cavity below the bearing head assembly. A passageway in the bearing head lines up with the oil cavity below the bearing head. Oil travels from the cavity through the passageway to the main



1 Engine Crankshaft
2 Flywheel Bushing
3 Flywheel Housing
4 Engine Flywheel
5 Ring Gear
6 Compressor Flywheel
7 Closure Plate
8 Compressor Housing
9 Retaining Pin
10 Drive Pin
11 Compressor Crankshaft
12 Seal Cover
13 Bearing Head O-ring Seal
14 Bearing Head
15 Gas Check Valve Assembly
16 Foam Breaker Plate
17 Piston Assembly
18 Suction Valve
19 Suction Valve Spring
20 Cylinder Liner
21 Retaining Ring
22 O-ring Seal
23 Suction Valve Plate
24 Discharge Valve Cage
25 Cylinder Head O-ring Seal
26 Cylinder Head
27 Eye Bolt
28 Discharge Valve Spring
29 Discharge Valve
30 Cylinder Head Spring
31 Discharge Valve Bolt
32 Discharge Valve Seat
33 Hand-hole Cover O-ring Seal
34 Hand-hole Cover
35 Oil Pump Mounting Bracket
36 Oil Pump Drive Assembly
37 Oil Pump Assembly
38 Crankshaft Counterweight
39 Connecting Rods
40 Sight Glass
41 Oil Strainer Assembly
42 O-ring Seal
43 Crankshaft Bearing (Large)
44 Locating Pin
45 Crankshaft Bearing (Small)
46 Retaining Ring
47 Thrust Collar Ball
48 Thrust Collar
49 Thrust Washer
50 Seal Assembly
51 Thrust Washer Pin
52 Oil Restriction Plug
53 Bolt Plate
54 Flywheel Retaining Bolt
55 Drive Key

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Figure 5—Compressor and Drive

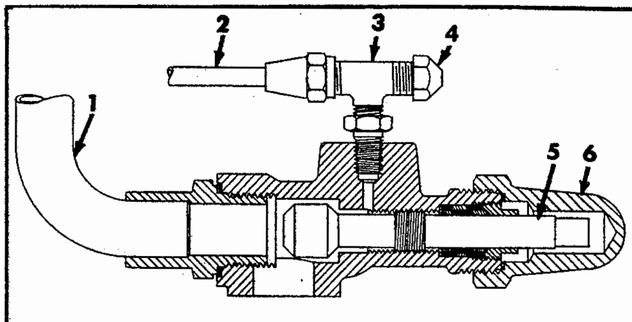
bearing. There are additional passages in the bearing head which conduct oil from the passageway to the crankshaft small bearing and to the shaft seal chamber. Oil enters the shaft seal chamber through an orifice plug in the bearing head. An oil passage in the crankshaft carries oil under pressure from the large bearing to the three connecting rods. Lubrication of the cylinder walls and the piston pins is accomplished by the oil mist in the crankcase. Each connecting rod has a small cup and hole at the top of the rod above the piston pin. Oil from the crankcase travels down through this hole to lubricate the piston pin.

COMPRESSOR SHUT-OFF VALVES (Fig. 6)

Double-seating shut-off valves are provided at the compressor discharge and suction ports. With both valve stems turned all the way in (closed), compressor is isolated from the rest of the system. Valve stems are turned all the way out to back-seated (fully open) position for making gauge connections or when disconnecting the hi-lo pressure cut-out switch refrigerant lines. "Operating Position" of valves, frequently referred to in this group, is with the valve stem cracked 1/2 to 1 turn from the backseated position as shown in figure 6, to admit system pressures into the gauge and hi-lo pressure cut-out switch tee fittings. IMPORTANT: Valve caps with gaskets must be in place and tight at all times during system operation.

COMPRESSOR OIL

As previously explained, when the compressor starts up the pressure in the crankcase is reduced rapidly, causing the oil to foam. If excessive foaming is permitted, the oil will leave the crankcase on start-up in such quantity that the lubricating system will not have sufficient oil to lubricate the bearings. It is undesirable to pump large quantities of oil out of the compressor and into the system, even though this oil would return to the compressor soon after start-up. Momentary loss of oil from the crankcase promotes premature bearing wear and can cause complete bearing failure should the oil not return to the compressor very quickly after start-up. Therefore, every effort must be made to insure that the oil does not leave the crankcase. As mentioned before, the main problem is oil-foaming. Two important steps have been taken to reduce oil-foaming and prevent loss of oil on start-up. A foam breaker is built into the compressor, and in addition, the oil used in the compressor contains a de-foamant. It is highly important that only the recommended refrigeration compressor oils which contain a de-foamant be used in this compressor. The approved oils for use in this compressor are listed in "LUBRICATION AND INSPECTION" later in this group. These oils can be obtained locally through refrigeration equipment suppliers. Oil should be purchased in sealed quart cans only. Never use bulk oil or oil which has been exposed to air.



1 Refrigerant Line
2 Valve to Hi-Lo Pressure Switch Line
3 Tee
4 Gauge Port Cap
5 Valve Stem
6 Valve Stem Cap

TPM-1844

Figure 6—Compressor Shut-Off Valve in "Operating Position"

IMPORTANT: USE ONLY APPROVED COMPRESSOR OILS.

The initial charge of oil in the compressor is 4 pints. After the compressor has been operated for about 30 minutes, the oil level should be about 1/4 to 1/2 of the way up on the compressor sight glass. If oil is near or below the bottom of the sight glass, oil should be added. The oil level should al-

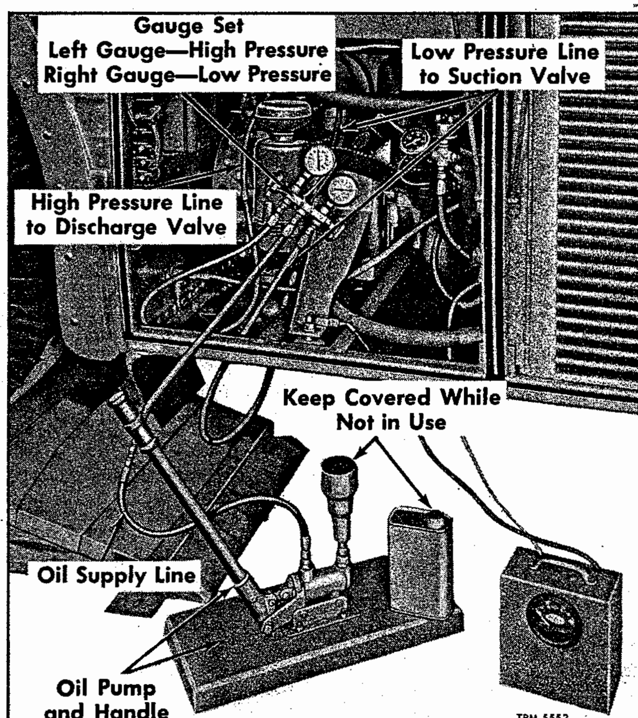


Figure 7—Method of Adding Compressor Oil

ways be checked with the compressor operating. Before adding oil, first determine and correct cause of loss of oil.

A new compressor or one having been overhauled should be drained and refilled after the first 200 hours of operation.

Adding Oil to a Charged System

When adding oil to a charged system, it is desirable to do so without losing refrigerant and without admitting air into the system.

Add oil to compressor in the following manner:

1. Referring to figure 7, connect the high pressure line from the gauge set to discharge valve of compressor and connect the low pressure line to compressor suction valve.
2. Purge air from gauge lines to compressor: Crack compressor discharge valve from full open position to allow refrigerant and air to escape from gauge center fitting. Close gauge valve only. Purge air from low pressure line in same manner leaving valves open for only a few seconds.
3. Connect supply line from oil pump loosely to center fitting of gauge set. Pour compressor oil into pump reservoir then after all air bubbles have disappeared operate pump to purge air from supply line. Tighten connection firmly at gauge set.
4. With gauge valves open and compressor valves in operating position start engine and operate for approximately 15 minutes. This will allow system to level. Observe compressor oil level and gauge pressures.
5. With engine still running, operate pump slowly. Observe oil level through compressor sight glass. IMPORTANT: Keep pump reservoir near full at all times to prevent air being pumped into system. Add oil until level is 1/4 to 1/2 way up on sight glass. Remove charging equipment, then place valves in operating position.

DRAINING OIL FROM COMPRESSOR

NOTE: The following procedure pertains to draining all the oil from compressor and entire system. However, to simply lower the oil level in the compressor itself, perform Step 3 only, as it is not necessary to pump down system, or to close compressor valves.

1. Pump down the system as explained later under "System Tests and Services."
2. Isolate compressor from rest of system by turning compressor valves off (turned completely clockwise).
3. At bottom of compressor remove cap from drain valve, then with a basin under valve, crack valve open slightly to drain.
4. Add new oil to compressor as directed previously under "Adding Oil to a Charged System."

COMPRESSOR MAINTENANCE

Compressor requires practically no maintenance other than making sure that sufficient (but not too much) oil and refrigerant is maintained in the system at all times. The lubrication system of the compressor will fail if the system loses its charge of oil or refrigerant. Both oil and refrigerant must be circulating through the compressor whenever it is running to prevent very serious damage. Check compressor mounting bolts periodically and tighten as necessary. Check carefully for indication of oil or refrigerant leakage. Leaks should be remedied promptly to prevent excessive refrigerant and oil loss. If necessary, compressor can be overhauled as explained later under "COMPRESSOR OVERHAUL."

COMPRESSOR STORAGE

1. If compressor is to remain on engine and is to remain inoperative for an extended period, a considerable amount of refrigerant could be lost through the shaft seal, because the shaft seal did not remain wetted. To prevent loss of refrigerant through the shaft seal, the compressor, suction, and discharge service valves should be closed (frontseated). This will isolate the compressor from the rest of the system. Another method of preventing loss of refrigerant through the compressor shaft seal when the compressor is idle for a long period of time, is to turn the engine over with the starter every four or five days. This will maintain a film of oil on the sealing surfaces of the seal and on the bearings.
2. If compressor is removed from engine and is to remain in storage off the engine, stand the compressor on end, drive end down, on blocks in such a way that no weight rests on the compressor shaft.

CONDENSER

The condenser coil is the medium through which the heat picked up by the refrigerant in the evaporator and the heat of compression is dissipated to the air. Since the heat in the gas must be dissipated through the walls of the coils and the fins, it is of extreme importance that the condenser be kept clean. THE IMPORTANCE OF KEEPING THE CONDENSER CLEAN CANNOT BE OVER-EMPHASIZED. When condenser becomes clogged or coated with dirt and road film, high head pressure and overloading of engine results. Condenser must be cleaned at frequent intervals.

Forward end of condenser is hinge mounted. Rear end can be swung out approximately 60 degrees after disengaging swing bolts from flange on condenser. This permits cleaning the unit from inner side.

A combination of water and air pressure blown through condenser coils from inner side is most satisfactory for loosening and removing dirt. Air pressure should not be high enough to bend the fins.

Swing condenser back to its normal operating position before starting the engine. If for any reason it is necessary to run the engine with condenser swung out while servicing the unit, run cold water over the unit. This precaution must be taken, since the fan will not be drawing air through the unit with the condenser swung out. If the condenser is left open with the engine running and no measures are taken to cool it, pressure may build up to a point where the hi-lo pressure switch will stop the unit.

Whenever a new condenser has been installed, the new condenser should be blown out with refrigerant before connecting refrigerant lines.

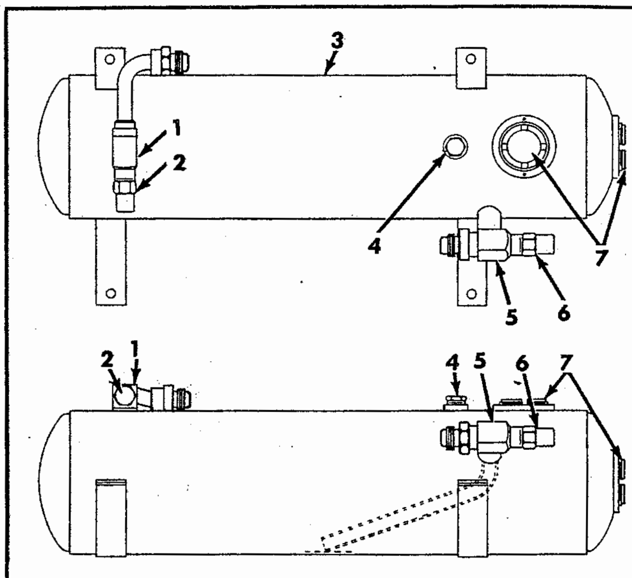
LIQUID RECEIVER

Liquid receiver (fig. 8) serves as a reservoir for a constant supply of liquid refrigerant ready for use in the evaporator. Two sight glasses are provided at outer end of receiver, one in end of tank and one in top of tank. A light bulb, installed over upper sight glass, is illuminated when "COMP'T LAMP" switch on control panel is in "ON" position. With light turned on, level of refrigerant can be readily seen in end sight glass. After unit has been running for 30 minutes or more, refrigerant level should be at center of end sight glass. In no case should the refrigerant level be above the sight glass or below it with the system operating. Refrigerant can be added to or removed from the system at the compressor suction valve as directed in "SYSTEM TESTS AND SERVICES" later in this group.

During operation of the system, both the receiver inlet and outlet valves must be fully open. To determine if valves are fully open, remove valve stem caps and turn valve stems counterclockwise to the limit of their travel. If air conditioning system fails to function and compressor is being driven properly, receiver valves should be the first place to check. The system positively will not function unless both of the receiver valves are open. A fusible safety plug is installed in top of receiver tank.

REFRIGERANT DEHYDRATOR - STRAINER

The refrigerant dehydrator-strainer, installed in the liquid line just ahead of the expansion valve as shown in figure 15, in "HEATING AND VENTILATION" (SEC. 3), removes foreign matter and



1 Liquid In Valve
2 Liquid In Valve Cap
3 Tank
4 Fusible Safety Plug
5 Receiver Outlet Valve
6 Outlet Valve Cap
7 Sight Glass
TPM-5405

Figure 8—Liquid Receiver

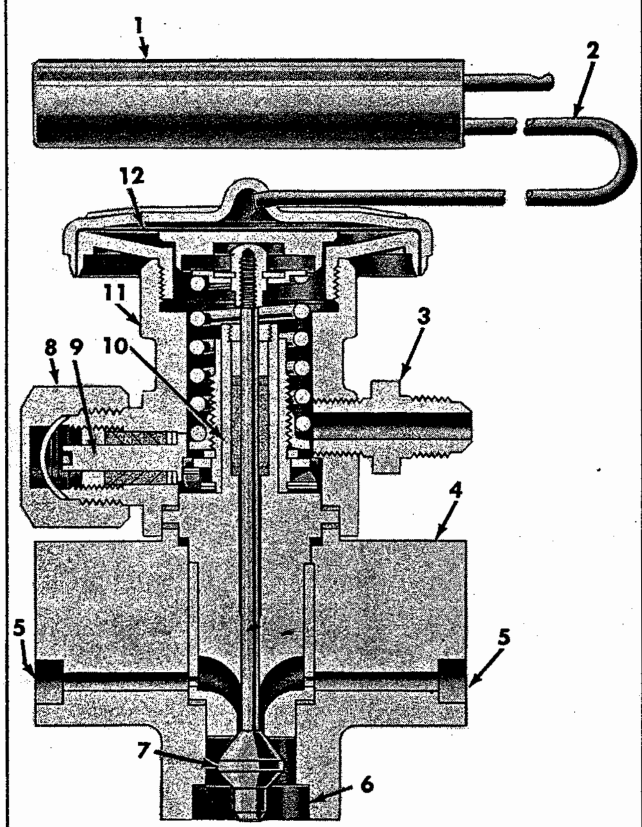
moisture from the liquid refrigerant before it reaches the expansion valve.

Strainer is of the disposable type, charged with activated alumina. The complete unit is discarded and replaced with a new unit.

Chemical used in unit has a high moisture absorbing capacity. Any moisture which has been inadvertently admitted into the system will be absorbed by the chemical. This does not mean that the system should not be evacuated when air and moisture has been admitted.

Whenever the system has been opened for any reason, the dehydrator-strainer should be replaced after a few hours of operation. The unit is accessible through the forward door at inner side of right front baggage compartment. Service dehydrator-strainer as follows:

1. Pump down the system as directed in "SYSTEM TESTS AND SERVICES" later in this group.
2. Use wrench on hex portion of upper end of unit to unscrew unit from fitting in liquid line. Remove sealing cap from new unit and immediately thread unit onto fitting in liquid line. Tighten firmly.
3. Open liquid receiver valves and compressor valves before placing the unit in operation. With system operating, test for leaks at dehydrator-strainer, using a Halide Torch. Refer to "Testing For Leaks" in "SYSTEM TESTS AND SERVICES" later in this group.



1 Remote Bulb	7 Valve
2 Capillary Tube	8 Adjusting Stem Cap
3 Equalizer Tube Connector	9 Adjusting Stem
4 Body Flange	10 Cage Assembly
5 Outlet Ports	11 Power Assembly
6 Inlet Port	12 Diaphragm

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Figure 9—Expansion Valve

EXPANSION VALVE

Expansion valve (fig. 9) is installed at right end of evaporator coil, and is accessible for servicing or replacement after removing the center panel from inner end of right front baggage compartment (fig. 15, Section 3). Expansion valve is set at the factory to provide the most efficient operation of the system, and should not normally require adjustment in the field. However, in the event a new evaporator coil and valve assembly or a new expansion valve power or cage assembly is installed, valve must be adjusted to provide the correct superheat at the evaporator outlet. In any event, do not adjust the expansion valve to compensate for insufficient cooling until all other possible causes, such as a dirty condenser, clogged or moisture soaked dehydrator cartridge, air in system, or low refrigerant charge are checked for and corrected.

EXPANSION VALVE OPERATION (Fig. 9)

Expansion valve is a multi-outlet thermo valve with external remote control bulb and external equalizer. Expansion valve regulates the flow of liquid refrigerant into the evaporator coils. Valve is primarily operated by the temperature of the suction gas leaving the evaporator, and is further controlled by the pressure in the evaporator through the equalizer tube. The combined effects of these two factors automatically control the quantity of liquid admitted into the evaporator.

Outlet end of valve is installed in body flange, which is connected by several small distributor tubes to the evaporator coils. Liquid line is connected to inlet port which extends through the center of the body flange. The remote bulb is inserted into the hollow end of the evaporator coil outlet manifold, where it is subjected to the temperature of the suction gas as it leaves the evaporator. Bulb is charged with liquid refrigerant which expands and contracts in accordance with the temperature of the suction gas. Expansion of refrigerant in bulb applies pressure against diaphragm in valve power assembly, causing valve to open.

Bulb tends to operate valve toward its open or closed position to regulate the flow of refrigerant into the evaporator as required. If too much liquid is admitted into the evaporator, all of it does not evaporate and some liquid approaches the remote bulb, lowering its temperature. This will cause the liquid in the bulb to contract, relieving pressure on diaphragm, and spring moves valve toward its closed position. If there is not enough liquid in the evaporator, the resulting increase in temperature of the suction gas raises temperature of bulb, causing valve to operate in its opening direction.

EXTERNAL EQUALIZER

The purpose of the external equalizer is to prevent flooding the evaporator coils when temperature of evaporator suddenly rises. Equalizer tube is connected into the evaporator coil outlet manifold and to the cavity below the diaphragm in the valve power assembly. Thus, when valve is suddenly opened wide by a high temperature in the suction gas, the heavy flow of liquid into the evaporator creates a high pressure which is carried to the under side of the diaphragm through the equalizer tube. This pressure below the diaphragm counteracts the pressure from the remote bulb and tends to move the valve toward its closed position.

CONSTRUCTION (Fig. 9)

The expansion valve has three basic component parts: The power assembly, cage assembly, and body flange. There are no working parts in the

body flange. The multi-outlet body flange is connected to evaporator by tubes with soldered connections. Power assembly and cage assembly can be removed from the body flange without breaking any soldered connections.

Always make sure the system is clean and dry before installing the expansion valve.

SUPERHEAT

Superheat is the temperature increase above the saturation point. When the liquid refrigerant boils or evaporates in the evaporator, heat is absorbed from the air passing through the evaporator coils, but the temperature of the gas does not rise above the boiling point until all the liquid has changed to gas. The heat thus absorbed is the latent heat of vaporization, producing a change in state with no change in temperature.

After the refrigerant has changed to gas, the temperature of the gas is still lower than the temperature of the air passing through the evaporator, so the gas will continue to absorb heat from the air and its temperature will rise a few degrees. This amount of rise above the saturation temperature is called "superheat."

Example: At 37 psi gauge pressure, the saturation temperature of refrigerant is 40°F.; that is, the liquid changes to gas at 40°F. If the temperature of the refrigerant gas at 37 psi gauge pressure is 48°F., the gas contains 8°F. of superheat. Superheating takes place after all the liquid has changed to gas, usually near the outlet end of the evaporator coils.

PRESSURE - TEMPERATURE

Pressure has a very definite relationship to the boiling point of any substance. There is a definite temperature at which a liquid will boil for every definite pressure exerted upon that liquid. Water, which boils at 212°F., under zero gauge pressure (atmospheric pressure at sea level), will boil at approximately 232°F., under 10 psi gauge pressure.

Likewise, refrigerant boils at -22°F. (22° below zero) under atmospheric pressure, and at 40°F., under 37 psi gauge pressure. An increase in pressure causes a rise in the boiling point.

The pressure temperature relationships shown in the table on this page are used for two purposes: For adjusting the expansion valve and for checking for air in the system. Method of checking for air in the system is described in "SYSTEM TESTS AND SERVICES" later in this section.

EXPANSION VALVE ADJUSTMENT

Valve should be adjusted to obtain 9 to 10 superheat with moderately heavy internal load. Refer to pressure-temperature chart.

REFRIGERANT PRESSURE-TEMPERATURE RELATIONSHIP

Temp. °F.	Gauge Pressure PSI	Temp. °F.	Gauge Pressure PSI
30	28	96	110
32	30	98	113
34	32	100	117
36	33	102	121
38	35	104	124
40	37	106	128
42	39	108	132
44	41	110	136
46	43	112	140
48	45	114	144
50	47	116	148
52	49	118	153
54	51	120	157
56	53	122	162
58	55	124	166
60	58	126	171
62	60	128	175
64	62	130	180
66	65	132	185
68	68	134	190
70	70	136	195
72	73	138	200
74	76	140	206
76	78	142	211
78	81	144	216
80	84	146	221
82	87	148	227
84	90	150	234
86	93	152	239
88	96	154	245
90	100	156	251
92	103	158	256
94	106	160	262

1. Apply small quantity of a thermo-type mastick to a remote-reading thermometer and attach to evaporator coil outlet, as shown in left view of figure 10. Thermo-mastick may be available at a local refrigeration service establishment, or it can be obtained from the Alco Valve Company, St. Louis, Missouri.

2. Connect a low pressure gauge at the compressor suction valve. To connect gauge, remove sealing cap from shut-off valve and turn valve stem counterclockwise to backseat the valve. Remove cap from tee fitting on side of valve and connect gauge line to tee fitting. Tighten gauge line connection at suction valve tee and loosen gauge line connection at gauge. Slightly crack suction valve to permit refrigerant gas to displace air in gauge line, then tighten connection at gauge. Leave suction valve cracked 1/2 to 1 turn from fully opened (backseated) position.

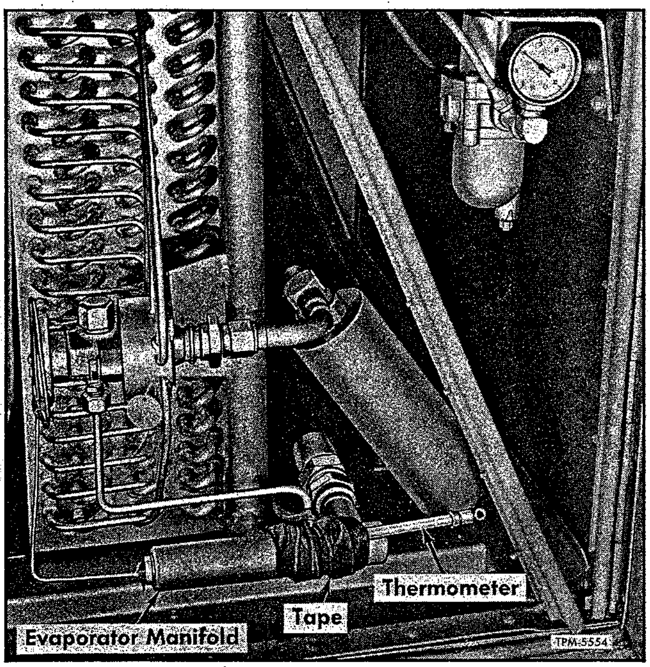


Figure 10—Checking Superheat

3. Compare pressure reading on gauge with temperature reading on thermometer against corresponding pressure in table. If necessary, remove cap from expansion valve adjusting stem; turn valve stem clockwise to decrease flow of refrigerant and increase superheat; turn valve stem counterclockwise to increase refrigerant flow and lower superheat. Two complete turns of the valve stem will change the actuating superheat approximately 1^{o} F.

4. After adjusting, wait about 30 minutes to check results.

5. To remove gauge, backseat the suction valve, disconnect gauge and install cap on tee fitting, then crack valve 1/2 to 1 turn from backseated position.

SERVICING THE EXPANSION VALVE (Fig. 9)

When necessary to clean, inspect, or replace parts, the power assembly and cage assembly may be removed without disconnecting any soldered joints.

1. Pump down the system as directed in "SYSTEM TESTS AND SERVICES" later in this group.

2. Disconnect the external equalizer line from power assembly. Pull remote bulb out of end of evaporator coil outlet manifold. Use care to prevent kinking or otherwise damaging capillary tubing.

3. Remove two cap screws attaching power assembly to body flange, remove power assembly, then lift out cage assembly.

4. When assembling valve, replace gaskets in proper places, and be sure the retaining pin on the valve cage enters the slot in the body flange.

5. Make sure the two lugs on the valve cage fit into grooves in the power assembly, and that the gear wheel on cage assembly meshes with adjusting gear in side of power assembly. Do not force the valve together - make the cage fit properly before tightening to the body flange.

CAUTION: If necessary to make soldered connections at body flange, first remove power assembly, cage assembly, and all gaskets. Keep heat away from all valve parts except the body flange.

6. Insert remote bulb into end of evaporator coil outlet manifold, making sure there are no sharp bends or kinks in the capillary tube.

EXPANSION VALVE FREEZES

Expansion valve trouble caused by moisture in system may be usually detected by an intermittent hissing sound at the expansion valve at high temperatures. Do not confuse this hissing sound with the hissing caused by a shortage of refrigerant. Excessive refrigerant causes a hissing sound accompanied by a pounding vibration. When operating at low temperatures, moisture is indicated by the above, and by the fact that when the compressor is shut down and the valve warms up, it will become operative again for a short time.

If there is moisture in the system, it is necessary to evacuate the system with a vacuum pump, then service the dehydrator-strainer. If moisture is still evident after one hour of operation, the dehydrator-strainer must be serviced again. Repeat until all moisture has been eliminated. Moisture trouble is caused by moist air entering piping when system is open, or from water in refrigerant container. Piping should be blown out with refrigerant before making final connections, particularly if piping has been open to air with high humidity content. After system has been pumped down and system opened, moisture is almost certain to be introduced. Always service the dehydrator-strainer whenever the system has been opened and service again after a few hours of operation.

Many chemical preparations to be added to the refrigerant are now offered commercially for correcting moisture trouble. These preparations are anti-freeze solutions and are not suitable for use in compressor used in this system. The best practice is to always service the dehydrator whenever the system has been opened. This absorbs the moisture rather than preventing it from freezing, and also eliminates the danger of corrosion of internal parts of system caused by the presence of moisture.

EVAPORATOR

Finned tube type evaporator is mounted in heating and cooling compartment under floor at

rear of front axle (fig. 15, Section 3). If the underfloor air filter installed ahead of the evaporator is serviced frequently enough, there should be no maintenance required on the evaporator. However, if servicing the filter is neglected, some particles of dust, lint, etc. may pass through the filter; since the evaporator coils and fins are moist, these particles will cling to them. Dirt on the coils and fins acts as insulation and reduces the efficiency of the system, and when operating in humid climates, objectionable odors may develop caused by a mold-like formation or growth. In the event the evaporator does become dirty, it must be cleaned with steam or hot water and some cleaning agent which is not harmful to the aluminum tubes and fins. Since the location of the evaporator is not conducive to thorough cleaning in the vehicle, and considerable time is required for removing the evaporator for cleaning, the importance of cleaning or changing the air filter at frequent intervals should be impressed upon all maintenance personnel.

AIR FILTER

AIR FILTER MUST BE KEPT CLEAN FOR SATISFACTORY OPERATION OF AIR CONDITIONING SYSTEM.

Instructions for cleaning filter are explained under "HEATING AND VENTILATION" (SEC. 3).

UNDERFLOOR BLOWER AND MOTOR

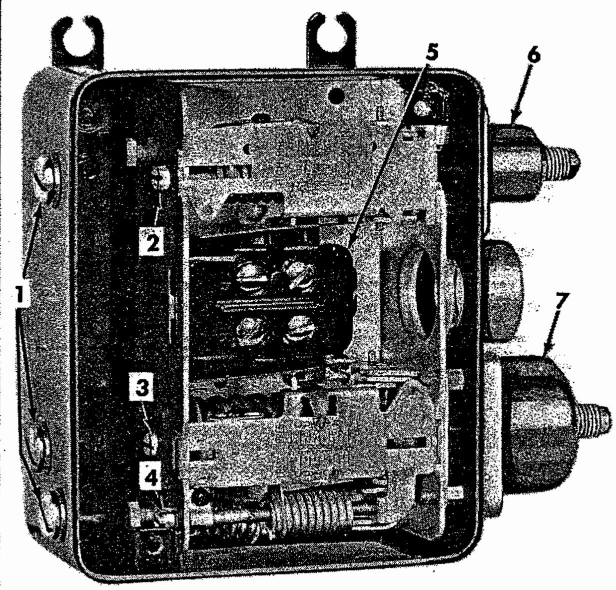
Complete maintenance instructions on the underfloor blower and motor are covered in "HEATING AND VENTILATION" (SEC. 3).

HI-LO PRESSURE CUT-OUT SWITCH

The hi-lo pressure switch (fig. 11) is a dual pressure control switch connected in series with the air conditioning engine control circuit, and actuated by the high side and low side refrigerant pressures. The control unit consists basically of two bellows, both of which are connected through spring-loaded toggle linkage to a set of contact points, all enclosed within a dust-proof case.

Low pressure cut-out and cut-in points are adjustable; high pressure cut-out point is adjustable, but the differential on the high pressure side of switch is fixed and non-adjustable. Openings are provided in case to permit making adjustments with a straight screwdriver.

Only two of the four wire terminals, LI and MI, are used on this installation. Opening where wires enter case is sealed by a threaded connec-



1 Access Plugs
2 High Pressure Cut-out Adjustment
3 Low Pressure Range Adjustment
4 Low Pressure Cut-out Adjustment
5 Contact Assembly
6 High Pressure Bellows
7 Low Pressure Bellows

TPM-1325

Figure 11—Hi-Lo Pressure Switch

tor. Either of the two bellows assemblies and the contact assembly are replaceable. When connecting hose to either bellows, it is extremely important to use a wrench on hex portion of bellows element while tightening hose fitting to prevent damaging bellows.

The hi-lo pressure cut-out switch is properly set at the factory and should not normally require adjustment in the field. However, in the event of improper operation, switch operation can be tested and adjusted, if necessary, as follows:

LOW PRESSURE TEST AND ADJUSTMENT

Low pressure cut-out is an extremely important adjustment. System will not function satisfactorily and possible damage to compressor may result if switch points fail to open near the designated pressure. In making the following test, an accurate compound (air pressure and vacuum) gauge should be used.

1. Remove cap from compressor suction valve and turn valve stem counterclockwise to backseat the valve. Remove cap from tee fitting on side of valve and connect gauge line to tee fitting. Tighten gauge line connection at suction valve tee and loosen connection at gauge. Slightly crack suction valve to permit refrigerant gas to displace air in gauge line, then tighten connection at gauge. Close

suction valve by turning valve stem in (clockwise) until valve seats.

2. Start engine and permit it to run until it stops, observing pressure reading on gauge at the instant the engine stops. Switch points should open and stop the engine at 7 psi gauge pressure.

3. Next allow pressure to build up while holding the "START" switch in "ON" position until starter cranks engine. Pressure reading on gauge when switch points close and complete starter circuit should be 22 psi.

4. If switch points do not open and close at gauge readings specified in steps 2 and 3, adjust as follows:

a. Remove switch cover, and remove adjusting hole plugs from case.

b. If only the cut-out point requires adjustment, turn adjusting screw "4." Indicator is calibrated in increments of 5 psi.

c. If the cut-in point requires adjustment, turn adjusting screw "3," which changes the cut-in and cut-out points an equal amount, then re-adjust cut-out point by turning screw "4."

d. After adjusting, recheck operation of unit as described above, then open suction valve on liquid receiver.

HIGH PRESSURE TEST AND ADJUSTMENT

The high pressure side of the switch should open the points and stop the engine at 250 psi gauge pressure, and should permit the points to close when pressure drops to 200 psi. The point at which the switch cuts out is adjustable, but the cut-in point is not adjustable. Test switch and adjust if necessary as follows, using an accurate high pressure gauge.

1. Remove cap from compressor discharge valve and turn valve stem counterclockwise to backseat the valve. Remove cap from tee fitting and connect gauge line to tee fitting. Tighten gauge line connection at tee fitting and loosen connection at gauge.

2. With both the suction and discharge valves in operating position (cracked 1/2 to 1 turn away from backseated position), start engine. Slowly close the discharge valve by turning valve stem clockwise and observe pressure reading on gauge the instant the engine stops. If gauge reading when engine stops is more or less than 250 psi, adjust by turning adjusting screw "2." CAUTION: If high pressure switch fails to stop engine when pressure reaches 275 psi, stop engine, as pressures in excess of this may damage other units.

3. Open discharge valve, then repeat test 2 above to recheck cut-out adjustment.

4. When pressure cut-out switch stops the engine at correct pressure, hold "START" switch in "ON" position until pressures equalize and observe reading on pressure gauge when circuit is completed. If switch does not permit points to close at 200 psi gauge pressure, the complete control unit should be replaced.

5. After completing tests and adjustments, install cover and install plugs in adjusting screw holes in case.

SOLDERED JOINTS

Success in soldering depends to a great extent on the care exercised in cleaning the surface, as solder will not adhere to a dirty or greasy surface. The following steps should be taken to prepare sweated joints:

1. Saw pipe off square and use a knife blade to remove any inside burr. Make certain that no filings and cuttings drop into pipe. Avoid sharp bends or kinks in all pipe.

2. Polish pipe and inside of fitting so metal surfaces to be sweated together are bright and clean. Use No. 00 steel wool for polishing. Do not use files, sandpaper, or emery cloth as they score the metal surfaces. Do not touch the cleaned surface with hand as the oil and perspiration will prevent the solder flowing as it should and invariably causes a leak.

3. Put a thin coat of "Nokorode" flux on the cleaned portion of both the fitting and tube. A stiff brush should be used for this purpose; NEVER USE YOUR FINGER. After the fitting is placed on the pipe, remove any excess flux that shows outside the fitting.

4. Heat the fitting as evenly as possible, allowing heat to be transferred from fitting to tube, so that the solder will flow uniformly within the joint. Never hold the flame in one spot. By touching the joint between the pipe and fitting with the special solder, 95% tin - 5% antimony (which MUST be used for this type work) it is very easy to tell when the temperature has reached a degree high enough to allow the sweating to take place. When the solder flows freely into the joint the torch should be held back in order to prevent the joint from becoming too hot. Care must be taken not to get the joint too hot, as this will burn off the flux, allowing oxidation to take place, also cause the solder to harden and alloy with the copper pipe. In smaller pipe of 3/4" O.D. and under, the solder can be fed into the joint from one point, but in the larger diameters it is recommended that the solder be fed into one side then into the other. As soon as a small fillet can be seen completely around the joint, the application of more solder will drip off and not add anything toward making a better joint. Any surplus solder should be wiped off with a dry paint brush or clean cloth.

5. Permit the connection to cool until the solder becomes set. 95-5 solder sets very rapidly

6. Occasionally, pipe ends become dented or damaged. In such cases it is recommended that the pipe end be sawed off beyond the damaged or dented section, or use a sizing tool to true up the end.

7. In sweating heavy connectors, care should be taken to allow more time for the solder to set, as these heavier fittings hold the heat longer and do not cool as quickly. The reverse is true on heating. Do not overheat the pipe while heating the fitting.

REFRIGERANT LINE CONNECTIONS

A rubber O-ring seal is used at refrigerant line connections to assure positive seal. After breaking connection remove old O-ring seal and install new seal in connection seal groove.

Before line is connected, apply clean compressor oil to O-ring seal to facilitate connection. Tighten line nut firmly to assure leakproof connection. Check for leaks as explained later under "System Tests and Services."

Compressor Overhaul

Before servicing compressor, the system must be evacuated and the unit removed from engine. These instructions are explained later under "SYSTEM TESTS AND SERVICES." See "To Evacuate The System" and "Compressor Removal" or "Engine and Compressor Removal."

When servicing parts of compressor, handle the parts carefully and protect them against rusting immediately upon removal from compressor. Before installing parts, wash with refrigeration compressor parts cleaner, then oil with new (clean) compressor oil. This applies especially to seal and bearing surfaces to prevent seizure when unit is first put in operation. Use new O-ring seals at build-up of compressor.

COMPRESSOR DISASSEMBLY

NOTE: Key numbers in text refer to figure 5.

CYLINDER HEAD AND DISCHARGE VALVE REMOVAL AND DISASSEMBLY

1. Remove all but two opposed cylinder head attaching bolts. Back off remaining bolts two or three full turns.

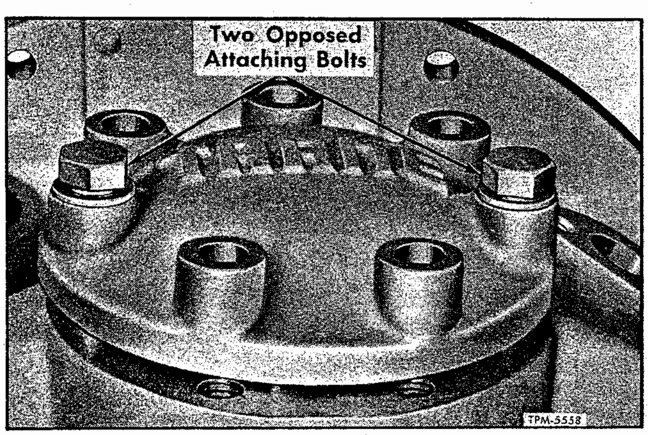


Figure 12—Method of Removing Cylinder Head Cover

2. Examine cylinder head (26) to see if head is following the attaching bolts (fig. 12). If not, tap the head with a plastic hammer until head O-ring seal (25) breaks loose.

3. Slowly and alternately remove two cylinder head bolts. Remove head and cylinder head spring (30) from compressor.

4. Remove O-ring seal (25) from groove in cylinder head.

5. Lift discharge valve assembly (24) from compressor.

6. Remove lock nut from discharge valve bolt (31). Remove bolt and valve seat (32). Separate discharge valve (29) and four springs (28) from discharge valve cage (24).

CYLINDER LINER AND SUCTION VALVE REMOVAL AND DISASSEMBLY

NOTE: The suction valve plate (23) is tapered in toward the top. A block of soft wood should be cut and shaped to fit into this taper (fig. 13).

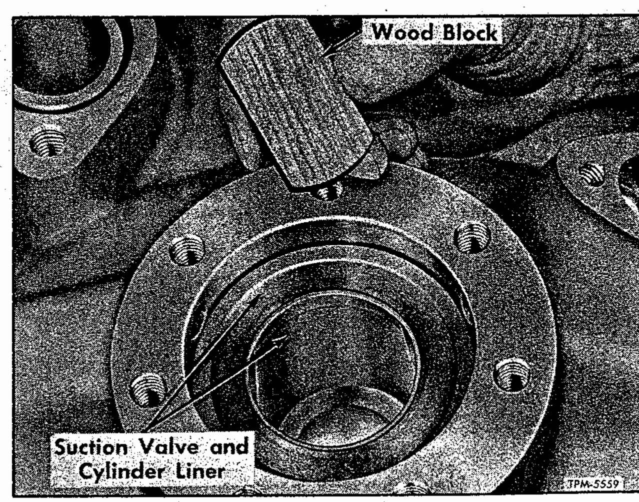


Figure 13—Wood Block Used for Removal of Suction Valve and Cylinder Liner

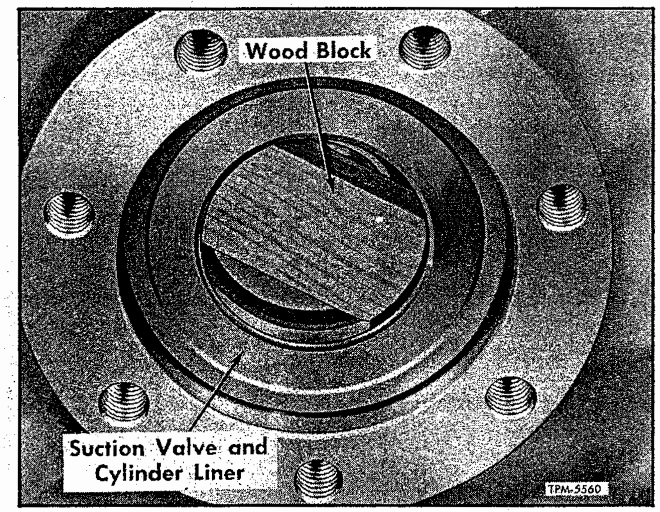


Figure 14—Removing Suction Valve and Cylinder Liner

1. Rotate the crankshaft until piston head is down about 2 inches from top, then place the wood block into cylinder. Rotate crankshaft to cause piston (17) to press block and cylinder liner (20) with suction valve from compressor bore (fig. 14). IMPORTANT: Do not bump piston against block, use an even pressure.

While liner is being withdrawn, support the piston through the liner so that the piston does not strike against compressor housing when liner breaks free.

2. Stand the cylinder liner and valve assembly on work bench. Remove the three valve plate retaining rings (21) from liner and plate. While not moving plate on liner, carefully invert entire assembly, then lift liner from suction valve (18), valve springs (19), and valve plate (23).

3. Remove O-ring seal (22) from suction valve plate (23).

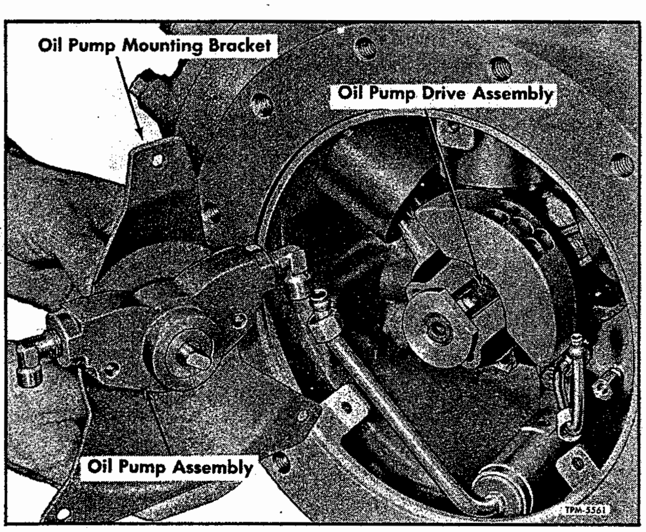


Figure 15—Oil Pump and Mounting Bracket Removed

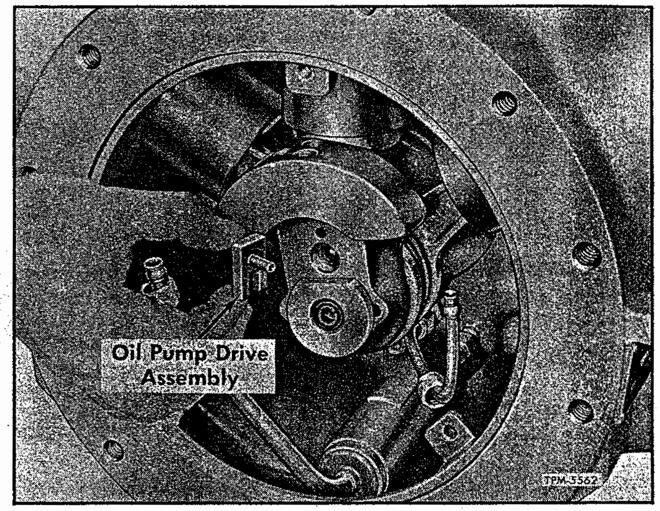


Figure 16—Removing Oil Pump Drive Assembly

HANDHOLE COVER REMOVAL

NOTE: Before removing cover (34) make sure that oil is drained from compressor.

1. Remove all handhole cover attaching cap screws except the top screw. Loosen this screw only. Screw will support the weight of cover when it breaks free from cover O-ring seal at opening. Tap cover with plastic hammer if necessary to free cover.

2. Remove top screw, then withdraw cover. Remove O-ring seal (33) from cover.

OIL PUMP AND OIL STRAINER REMOVAL

1. Disconnect oil line fitting nuts from elbow at each end of oil pump assembly (37).

2. Loosen only, the two hex head cap screws which attach oil pump assembly to the oil pump mounting bracket (35).

3. Remove the three cap screws which attach the oil pump bracket to compressor housing. Withdraw pump and pump bracket from compressor making sure oil lines are completely disengaged from elbows (fig. 15).

4. Remove the two cap screws previously loosened, attaching oil pump assembly to pump bracket. If necessary remove line elbows from pump.

NOTE: Do not attempt to repair pump assembly. If pump becomes inoperative, the complete assembly should be replaced.

5. Rotate crankshaft so that counterweight (38) is at top. Remove cap screw and lock washer attaching oil strainer assembly (41) to compressor housing. Remove strainer assembly.

CONNECTING ROD AND PISTON REMOVAL AND DISASSEMBLY

NOTE: Remove connecting rods and pistons in following sequence: From center cylinder first,

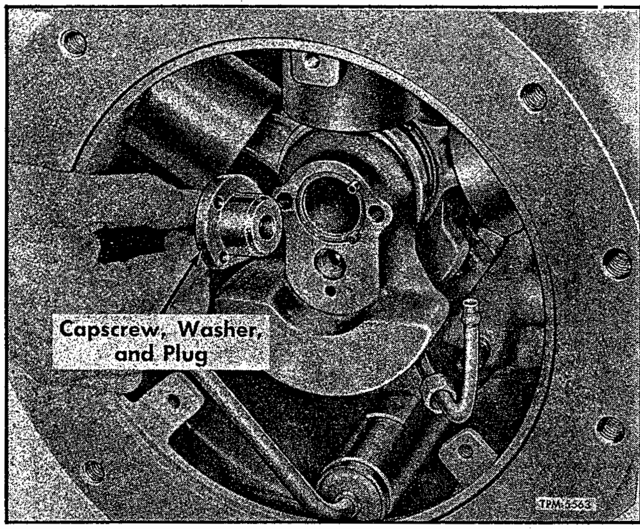


Figure 17—Replacing Plug, Washer, and Cap Screw

from left-hand cylinder next, and right-hand cylinder last.

1. Remove the oil pump drive assembly (36) in manner shown in figure 16.

2. Remove socket head cap screw, lock washer, and plug which retain counterweight (38) on compressor crankshaft (fig. 17). Use two puller screws (1/4-28 x 2") to force counterweight from crankshaft (fig. 18). Use care not to loosen the two dowel pins in counterweight.

3. Remove connecting rods and pistons carefully from compressor in sequence stated above.

4. Remove piston rings from piston.

5. Using a Tru-Arc pliers, remove two snap rings holding piston wrist pin in piston. Drive pin from piston and rod using a wood or soft metal driver. Do not nick piston or distort the wrist pin hole.

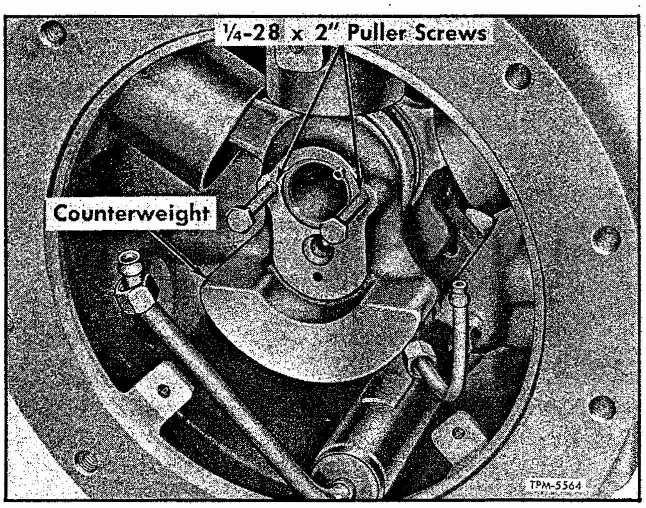


Figure 18—Method of Pulling Crankshaft Counterweight

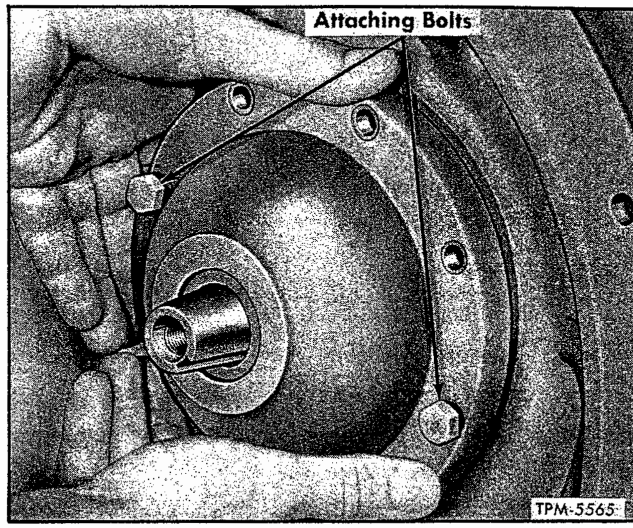


Figure 19—Method of Removing Crankshaft Seal Cover

COMPRESSOR FLYWHEEL REMOVAL

1. Remove bolt (54) and bolt plate (53) which secures compressor flywheel (6) to compressor crankshaft.

2. Pull flywheel (6) from crankshaft and remove drive key (55) from slot in crankshaft.

COMPRESSOR SHAFT SEAL REMOVAL

1. Loosen and remove all but two opposed cap screws which retain seal cover (12) to compressor housing (8) (fig. 19). Slowly and alternately turn remaining two cap screws from housing making sure seal cover follows screws. Seal spring should force cover from compressor housing. If necessary, tap cover lightly with plastic hammer to break seal between cover and housing.

2. Remove seal cover evenly from compressor shaft so as not to damage seal assembly (50). Pull seal assembly carefully from compressor shaft.

3. Remove rubber O-ring seal (13) from seal cover or bearing head.

CRANKSHAFT AND BEARING HEAD REMOVAL AND DISASSEMBLY

1. Tip the compressor upright on work bench (pump end downward). Grasp end of crankshaft, then slowly and carefully pull the crankshaft and bearing head assembly from compressor.

2. Place crankshaft and head assembly on clean work bench. Remove rubber O-ring seal (42) from groove in bearing head (14).

3. Using Tru-Arc pliers, remove snap ring (46) which retains thrust collar (48) on shaft. Remove thrust collar and the small ball (47) from depression on crankshaft (fig. 20).

4. Slide bearing head (14) from crankshaft.

5. If necessary, thrust washer (49) and oil re-

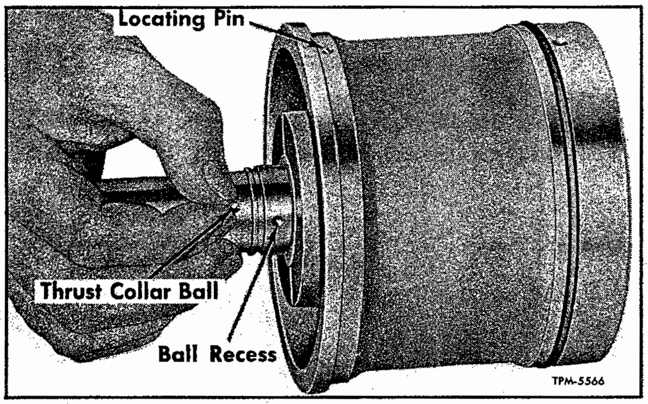


Figure 20—Thrust Collar Ball Location

striction plug (52) can be removed from bearing head.

NOTE: Crankshaft bushings (43 and 45) in bearing head are not serviced. If bushings are worn considerably, replace bearing head assembly.

FOAM BREAKER REMOVAL

Two foam breaker screens are located in compressor cavities as shown in figure 21.

Remove three screws and lock washers which attach the foam breaker retaining plate (16) to compressor housing. Remove plate, then remove foam breaker screens.

RELIEF VALVE, OIL LINE FITTING, OIL CHECK VALVE AND GAS CHECK VALVE REMOVAL

1. Relief valve, oil line fitting, and oil check valve are located at rear of compressor as shown in figure 21. Remove these units from compressor housing.

2. Gas check valve assembly (15) is located in the suction cavity of compressor housing as shown. Using a short handle wrench, remove valve.

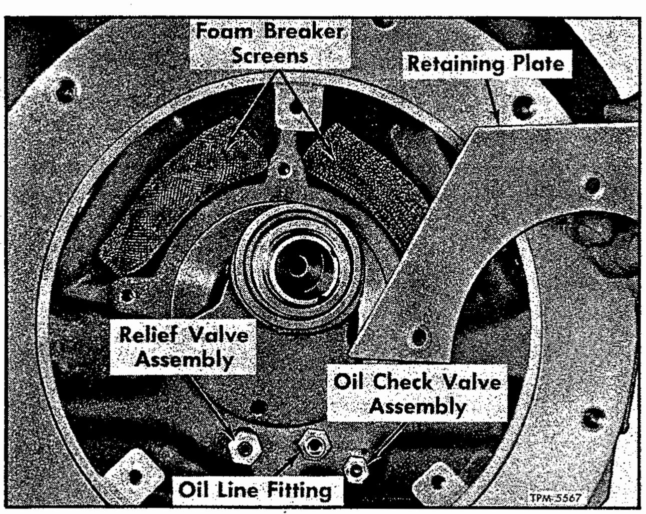


Figure 21—Foam Breaker, Screen, and Valves Installed

Figure 22—Checking Piston Ring Groove Clearance

CLEANING AND INSPECTION

CLEANING

1. Clean all compressor components in refrigeration compressor parts cleanser. Use a stiff bristle brush if necessary to loosen foreign particles. Direct compressor air through all passages in castings.

2. Use a small soft wire to clean oil restriction plug (52, fig. 5) in bearing head.

INSPECTION

1. Inspect compressor housing and other tapped components for cross threads and other damage.

2. Relief valve, gas check valve, and oil check valve can be disassembled and components cleaned and inspected. If ball within unit does not seat properly, replace entire valve assembly.

3. Examine surfaces of compressor valve components. Replace worn parts.

4. Inspect pistons for scoring, cracks, or damage of any kind.

5. Check fit of rings in piston ring grooves. Use back edge of ring to check fit (fig. 22). Rings should move freely in piston grooves.

COMPRESSOR BUILD-UP

Before building up compressor, coat all components with clean compressor oil. This will provide initial lubrication and prevent rusting.

Use new O-ring seals when assembling compressor.

NOTE: Key numbers in following text refer to figure 5.

RELIEF VALVE, OIL LINE FITTING, OIL CHECK VALVE, AND GAS CHECK VALVE INSTALLATION

1. Install gas check valve assembly (15) into compressor housing. Tighten valve firmly.

2. Install relief valve, oil line fitting, and check valve into rear of compressor as shown in figure 21. Tighten units firmly.

FOAM BREAKER INSTALLATION

1. Carefully roll foam breaker screens into approximate shape and insert into cavities in compressor housing.

2. Install foam breaker retaining plate (16) with three screws and lock washers. See figure 21.

CRANKSHAFT AND BEARING HEAD ASSEMBLY AND INSTALLATION

1. If thrust washer (49) and oil restriction plug (52) was removed from bearing head, install these parts. Install washer with oil grooves away from bearing head.

2. Insert crankshaft (11) into bearing head, then, position small ball (47) into depression on crankshaft as shown in figure 20. Install thrust collar (48) on crankshaft with groove in collar aligning over ball on crankshaft.

3. Install thrust collar retaining ring (46) against thrust collar. Be sure that retaining ring is firmly seated in crankshaft groove.

4. Install rubber O-ring seal (42) into groove at rear of bearing head (14).

5. With compressor oil applied to O-ring seal insert crankshaft and bearing head assembly into compressor housing making sure locating pin (44) on bearing head (fig. 20) engages groove in compressor housing.

CONNECTING ROD AND PISTON ASSEMBLY AND INSTALLATION

1. Position connecting rod in piston and drive wrist pin through piston and rod using a hammer and brass driving rod. Install snap rings into piston groove at each end of wrist pin.

2. Work piston rings carefully down over piston to their proper groove, using shim stock to aid in positioning rings. Oil ring is installed in bottom groove while compression rings are installed in two upper grooves.

IMPORTANT: Compression rings are tapered. Taper should be checked by eye and the rings placed on piston so that ring taper is toward the top of piston. Make sure rings are free in groove.

3. NOTE: Connecting rod and piston assemblies are installed in the reverse order of their removal. As viewed from rear of compressor, install right assembly, left assembly, then the center assembly last (fig. 23).

Clean surface of crankshaft thoroughly, then lubricate freely with compressor oil.

4. Rotate crankshaft so that piston of first rod to be installed will be at bottom of its stroke. Slide rod on crankshaft.

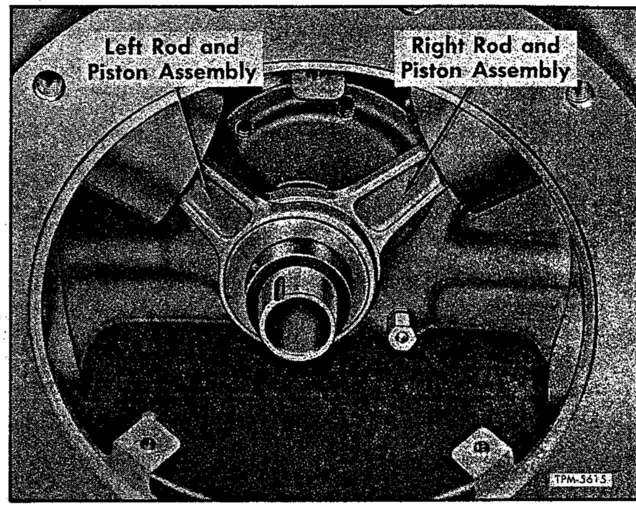


Figure 23—Right and Left Connecting Rods Installed

NOTE: After placing each rod on shaft install each respective cylinder liner and suction valve assembly as explained later under "Cylinder Liner and Suction Valve Assembly and Installation."

5. Clean and oil the surface of crankshaft which is to contact the crankshaft counterweight (38). Align counterweight dowel pins with locating holes in crankshaft, then press counterweight to crankshaft. Tap counterweight to seat it firmly to shaft.

6. Install plug into crankshaft end (fig. 17). NOTE: The dowel pins which extend beyond counterweight must align with recesses in plug. Install lock washer and cap screw. Tighten cap screw to 23 ft.-lbs. torque.

7. Insert the oil pump drive assembly (36) in manner shown in figure 16.

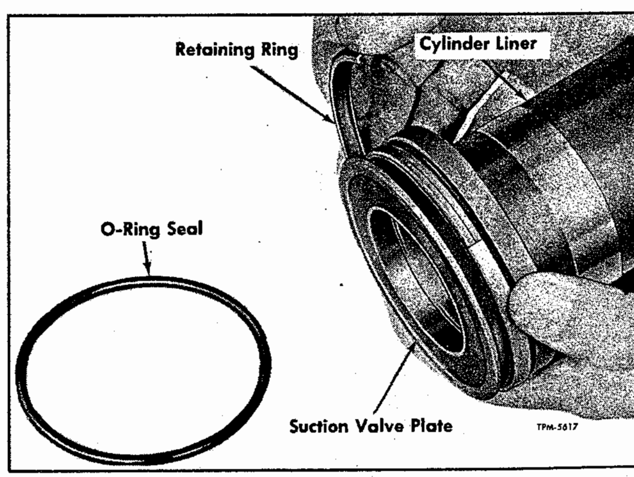


Figure 24—Installing Suction Valve Plate and Retaining Rings

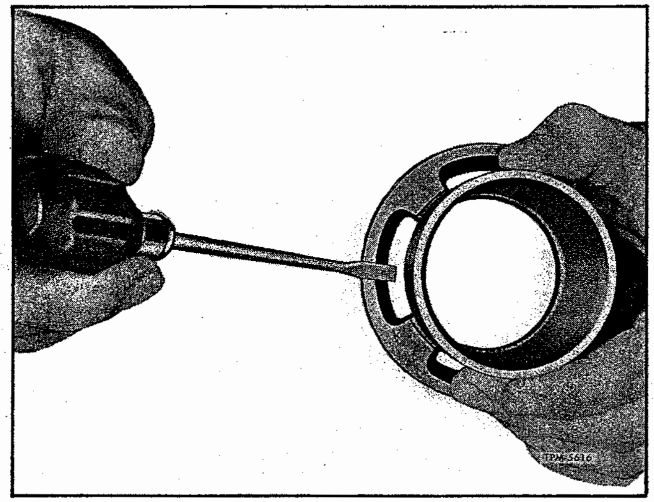


Figure 25—Checking Suction Valve Alignment

SUCTION VALVE AND CYLINDER LINER ASSEMBLY AND INSTALLATION

1. Apply compressor oil to O-ring seal (22), then install seal into groove of suction valve plate (23).

2. Invert suction valve plate (23) on bench, then place four springs (19) into spring pockets. Center the suction valve (18) over springs.

3. Lower the cylinder liner (20) down over valve to suction plate, then install three retaining ring segments (21) to retain suction valve plate to cylinder liner (fig. 24). Make sure suction valve is properly seated on valve seat (fig. 25).

4. Before placing liner and valve assembly into cylinder down over piston, rotate piston rings on piston to stagger gaps of rings.

5. Rotate crankshaft to bottom of its stroke. Place the liner into cylinder and center piston below liner. Push liner down over piston and rings and rotate crankshaft to force piston up into liner.

CAUTION: Do not hammer or attempt to force liner over piston rings. A sudden shock will cause ring breakage.

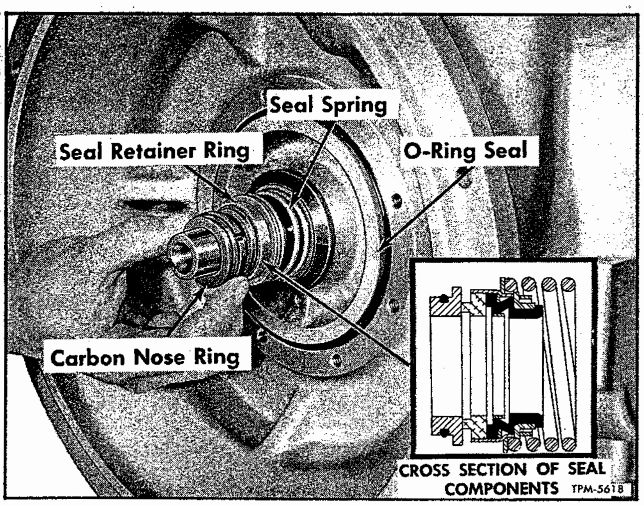


Figure 26—Installing Seal Components

OIL STRAINER AND OIL PUMP INSTALLATION

1. Guide the oil strainer assembly (41) into compressor housing. Install strainer attaching screw and lock washer. Tighten screw firmly.

2. Install oil line elbows into oil pump body if previously removed.

3. Attach oil pump mounting bracket (35) to oil pump with two cap screws and lock washers. Tighten screws hand tight.

4. Turn the oil pump drive key to the position required to engage oil pump drive as shown in figure 15. Position oil pump with mounting bracket in place, then attach bracket loosely to compressor housing with three cap screws and lock washers.

5. Engage and connect oil suction and discharge lines to elbows on oil pump. Tighten two pump-to-bracket attaching cap screws to 14 ft.-lbs. torque, and three pump bracket-to-compressor housing attaching cap screws to 6 ft.-lbs. torque. Tighten oil line fitting nuts to obtain leak-proof connections.

HAND HOLE COVER INSTALLATION

1. Apply compressor oil to cover O-ring seal (33) then place seal around edge of cover projection.

2. Position cover (34) with seal (33) to compressor housing. Install cover attaching cap screws evenly. Final torque screws to 43 ft.-lbs.

DISCHARGE VALVE AND CYLINDER HEAD INSTALLATION

1. Invert discharge valve cage (24) on bench, then place four discharge valve springs (28) into spring pockets of cage.

2. Center the discharge valve (29) over springs. Assembly valve seat (32) and seat bolt (31) then install seat and bolt through valve cage. Install nut on seat bolt. Before tightening nut, make sure discharge valve (24) registers in valve guides of cage. Tighten nut to 14 ft.-lbs. torque.

3. Position discharge valve assembly on top of suction valve plate in cylinder. Make certain valve cage is properly seated.

4. Place the cylinder head O-ring seal (25) around head projection.

5. Lower cylinder head spring (30) over guides of discharge valve cage in cylinder.

6. Attach cylinder head (26) to compressor housing with seven cap screws. Install cap screws evenly to a final torque of 43 ft.-lbs.

COMPRESSOR SHAFT SEAL AND COVER INSTALLATION

NOTE: The seal assembly (50) must always be replaced as an assembly. Before inserting seal assembly on shaft, clean seal surface on shaft and apply compressor oil to sealing surfaces.

1. Install O-ring seal (13) against compressor or housing around bearing head (fig. 26).

2. Position seal spring on compressor shaft (fig. 26).

3. Making sure that carbon nose ring is clean, (do not touch with fingers after cleaning), wet face of ring with compressor oil. Place nose ring into ring retainer, making sure that notches in retainer are properly aligned with notches in nose ring. Install seal assembly against spring (fig. 25).

4. Clean seal cover (12) and oil the O-ring seal of seal assembly (50), then install cover over seal evenly to compressor housing. Install cover attaching cap screws alternately to a torque of 12 ft. lbs.

COMPRESSOR FLYWHEEL INSTALLATION

1. Insert drive key (55) into keyway of crankshaft.

2. Position compressor flywheel (6) on crankshaft engaging drive key. Secure flywheel to crankshaft with bolt plate (53) and bolt (54). Tighten bolt to 55 ft.-lbs. torque.

Power Plant Maintenance

ENGINE

The four-cylinder, four-cycle, gasoline engine is of conventional L-head type. Engine operates at a constant speed which is maintained by a gear-driven flyball type governor.

For test and adjustment purposes, engine may be operated and controlled from the unit compartment as previously explained in "OPERATING INSTRUCTIONS" in this group.

NOTE: The terms "Front" and "Rear" as applied to the engine do not relate to the position of the engine in the coach. These terms follow common usage as applied to engines. "Front" designates timing gear end, and "Rear" designates flywheel end. "Right" and "Left" are applied as viewed from flywheel end.

LUBRICATION AND INSPECTION

Reference should be made to "LUBRICATION AND INSPECTION" later in this group for necessary inspection, servicing, and lubrication of the power plant.

It should be kept in mind that as the temperature of the air increases, compressor load on engine also increases; therefore, under conditions of prolonged high temperature, frequency of inspection and maintenance should also be increased.

The importance of regular and proper inspection, maintenance, and lubrication cannot be overemphasized.

ENGINE TUNE-UP

GENERAL

Engine should be tuned at intervals of 50 hours of operation. Results obtained from an engine tune-up may be unsatisfactory if a "hit-and-miss" method is used instead of a systematic approach to the job; therefore, the logical solution is a complete check-up, following and carrying out each step as directed below:

NOTE: Before tune-up procedure is started, it is important that air cleaner be serviced as directed later in this group. Reference should be made to "TROUBLE SHOOTING" later in this group for engine operating trouble symptoms and causes.

COMPRESSION TEST

Compression test is made to determine the need of internal repairs before tune-up procedures are accomplished. This test will indicate condition of piston rings and valve mechanism. Compression pressure depends upon cranking speed, engine temperature, oil viscosity, compression ratio, and general condition of the engine. An engine without fairly even compression cannot be successfully tuned. Make compression test in the following manner:

1. Remove all spark plugs. Insert compression gauge in No. 1 spark plug hole. Crank engine 10 or 12 turns with starter. Note highest gauge reading while engine is being cranked. Take a reading at each cylinder in the same manner.

2. Analyze the readings. While readings on some engines may be higher than on others due to conditions mentioned above, the readings on any one engine should be reasonably high (100 psi or more) and all cylinders should show uniform readings within approximately 10 psi.

3. Should one or more cylinders show reading indicating low compression, pour a liberal amount of light engine oil through spark plug hole in cylinder having low reading. Allow sufficient time for oil to spread around rings, then take

another reading. If compression is appreciably increased in cylinder so treated, piston or rings require replacement. If no change in compression reading is noted, check the valve mechanism.

4. An extremely low reading in two adjacent cylinders may indicate a cylinder head gasket leak.

VACUUM GAUGE TEST

The vacuum gauge, when used according to manufacturer's direction, is a useful aid to engine tune-up. With it one may quickly localize such conditions as listed below:

Remove pipe plug from intake manifold, then attach vacuum gauge to intake manifold. Disconnect carburetor throttle rod from governor lever, and operate throttle by hand. CAUTION: Do not permit engine to overspeed. With carburetor adjustments made as given above, run engine at normal idling speed. Vacuum gauge reading should be 18 to 21 inches, and indicator should be steady. Diagnosis of engine condition can be made by observing action of gauge as follows:

1. Gauge action with engine running at idling speed. If indicator drops several inches at regulator intervals the cause is generally a valve sticking or a defective spark plug.

2. If indicator drops occasionally, a spark plug is not firing or the gap is set too close.

3. If the reading is low with a steady indicator, the causes may be late ignition timing, leaky manifold gaskets, or valves adjusted too tight.

4. If the reading is high with indicator varying from 6 to 12 inches every revolution, the cause is generally late valve timing.

5. Gauge action on acceleration and deceleration. With engine idling, open throttle quickly. Vacuum should fall to 2 inches. Close throttle. Gauge should then read at least 24 inches. If reading is low on deceleration, diluted oil or defective piston rings usually are the cause.

TUNE-UP SEQUENCE

1. Spark Plugs. Refer to "Spark Plugs" later in this group for detail instructions.

a. Check to be sure that proper make and type are being used.

b. Clean plugs, using an abrasive blast-type spark plug cleaner.

c. Inspect porcelain. If cracked or broken, replace spark plug.

d. Set spark plug gap to dimension given under "Specifications" later in this group, using a round feeler gauge. When regapping is necessary, adjust side electrode only. Do not bend center electrode.

e. Be sure plug is installed firmly and that gasket is in good condition.

CAUTION: Tighten plug until it bottoms on gasket, then tighten an additional 1/4 to 1/2 turn.

2. Battery and Wiring. Refer to ELECTRICAL (SEC. 7) for information on battery.

a. Check engine ground straps. Be sure straps are in good condition and terminals are clean and tight.

b. Check starter and magnetic switch cables. Be sure cables are in good condition and terminals are clean and tight.

c. Check spark plug cables and other ignition wires. Terminals on each end must be tight and clean. If insulation shows evidence of deterioration, cables or wires should be replaced.

3. Magneto. Refer to "Ignition System" later in this group for detail information.

a. Check breaker points for pitting or burned condition. Replace points if they cannot be cleaned up or filed. Do not use emery cloth to clean distributor points.

b. Check point opening with a dial indicator. Refer to "Specifications" later in this group for breaker point opening.

c. Check magneto end cap. Replace if cracked or if posts are burned appreciably.

d. Examine the high tension lead brush and replace if noticeably worn or damaged.

e. Check distributor point condenser for efficiency of operation.

4. Valve Clearance. Refer to "Specifications" at rear of this group for detail information.

a. Tighten cylinder head studs.

b. Check valve lash against clearances listed in "Specifications" at rear of this group.

c. Make visual inspection of valve springs for pits or fractures.

5. Carburetor. Refer to "Fuel System" later in this group for detail information.

a. Check carburetor flange and intake manifold gasket for leaks.

b. Check float level. Refer to "Specifications" later in this group for dimension.

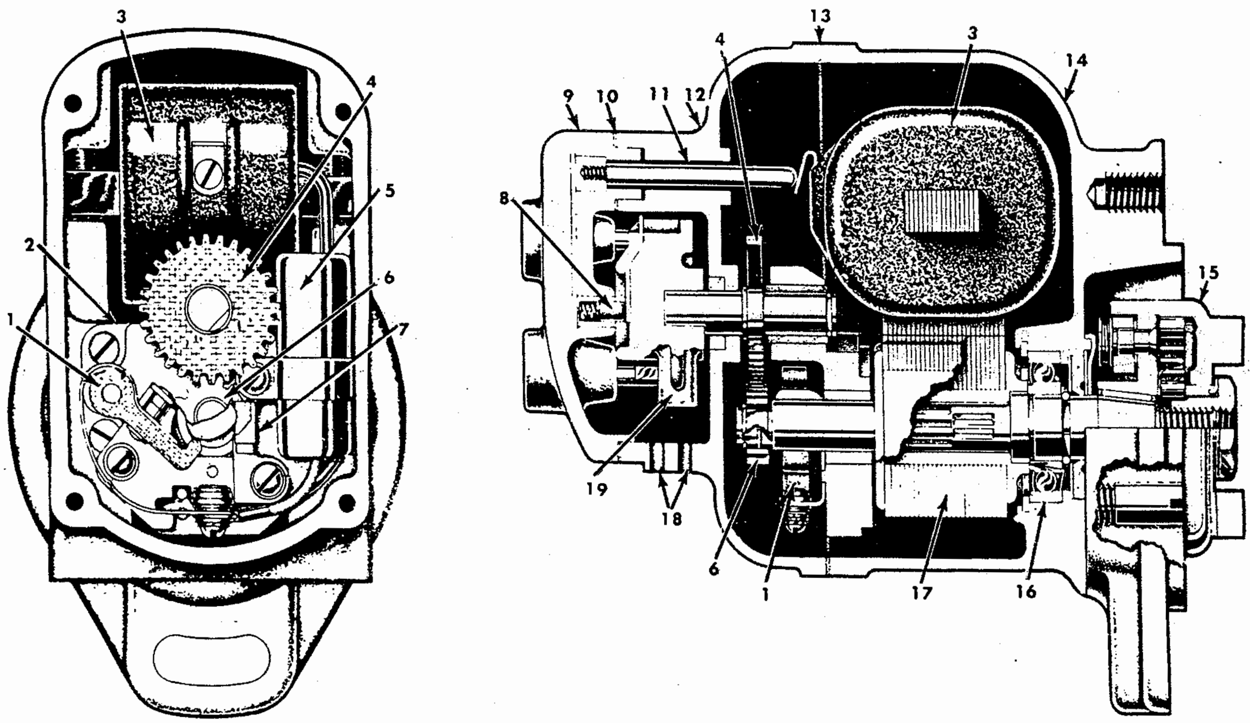
c. Adjust throttle controls as directed under "Governor and Throttle" later in this group.

IGNITION SYSTEM

The ignition system is designed to provide quick, easy starting and maximum dependability of operation without adjustment or service. Field adjustments are rarely necessary and, although very simple, they should be made only in accordance with the instructions which follow.

MAGNETO

Improper functioning of the magneto is often believed to be the cause of engine difficulty arising from other sources, such as flooded carburetor, insufficient fuel or air, loose ignition connections,



1 Breaker Arm
2 Contact Point Support
3 Coil
4 Distributor Gear
5 Condenser
6 Magnetic Rotor Gear
7 Cam Wick
8 Brush and Spring Assembly
9 End Cap Cover
10 End Cap Cover Gasket
11 High Tension Lead Rod
12 End Cap
13 End Cap Gasket
14 Frame
15 Impulse Coupling Assembly
16 Magnetic Rotor Drive End Bearing
17 Magnetic Rotor
18 Air Passages
19 Distributor Rotor

TPM-1889

Figure 27—Magneto Cross-Section and End View with End Cap Removed

or a defective spark plug. Since a brief engine inspection will usually localize the trouble before the magneto is reached, it often prevents maladjustments of parts in good condition. Magnetos (fig. 27) are assembled in sealed frames which should be opened only when it is certain that the ignition spark is unsatisfactory. This condition may be determined by ignition spark tests which are easily made in the field.

TESTING THE IGNITION SPARK

With spark plugs in good condition and properly adjusted, the ignition spark should be strong enough to bridge a short gap in addition to the actual spark plug discharge. This may be determined by holding the end of the ignition cable not more than 1/16 inch away from the spark plug terminal. The engine should not misfire when this is done. Ignition tests made while any part of the system is wet are useless.

TESTING THE MAGNETO SPARK

Remove all the ignition cables from the end cap cover sockets and insert a short, stiff wire in one of the sockets. Bend this wire to within 1/8 inch of the engine block. Turn the engine over slowly two complete revolutions and watch carefully for the spark discharge which should occur once during the cycle at the instant the impulse coupling releases. Repeat this test with the wire in each of the other sockets. If a strong spark is observed with the wire in each socket, it is recommended that the magneto be eliminated as the source of difficulty and that the cables, terminals, and spark plugs be thoroughly inspected. If no spark occurs, examine the magneto cut-out relay points to make sure they are not closed. Circuit must be complete through relay coil to hold points open. Circuit may be interrupted by safety switch being turned off or by excessively high or low refrigerant pressure.

END CAP COVER REMOVAL

If no spark is obtained from one or more of the magneto terminals, remove the end cap cover, using care not to damage the gasket. Remove the distributor rotor and clean the distributor com-

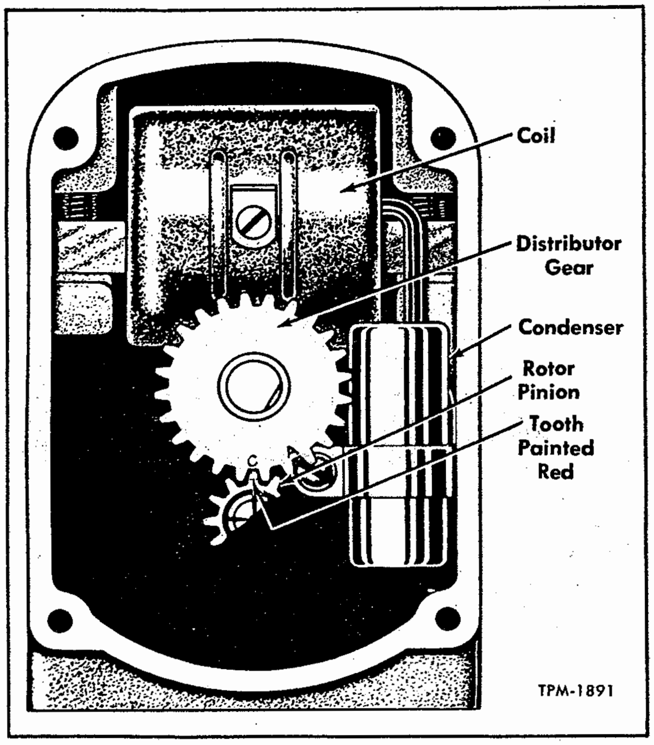


Figure 28—Magneto Internal Timing

partment thoroughly, making sure the air passages are open. IT IS EXTREMELY IMPORTANT THAT THESE AIR PASSAGES BE KEPT OPEN. If these passages are obstructed for any appreciable length of time, corrosion of all metal parts within the end cap will occur. Examine the high-tension lead brush and replace it if noticeably worn or damaged. Brush should move freely in its holder and should be under slight spring pressure.

BREAKER POINT SERVICE

Before examining the breaker points, it is first necessary to remove the end cap, which is sealed to the metal frame by a gasket joint. Breaker points should be inspected for evidence of pitting or pyramiding. If only slightly damaged, points can be resurfaced, using a small tungsten file or fine stone. If badly worn or pitted, points should be replaced. If points are resurfaced or replaced, they must be adjusted for proper gap. Correct point opening is 0.015 inch at full separation. Adjustment is made as follows:

Loosen slightly the two breaker arm locking screws, then move the contact support until the proper breaker point opening is obtained. This is accomplished by means of screwdriver inserted in the horizontal slot at the bottom of the contact support and pivoted between the two small bosses on the bearing support. This causes a slight rotation of the contact support around the small boss on the bearing support just above the breaker arm terminal screw. Lock the adjustment by tightening the locking screws. Make a final check of the adjustment after tightening the locking screws.

OTHER FIELD SERVICE

The cam felt wick, if dry or hard, should be replaced with new factory-impregnated wick. Other than this, the magneto does not require field lubrication and no attempt should be made to lubricate the bearings. The lubricant should be renewed only during a complete overhaul of the magneto by a Factory-Authorized Magneto Service Station. Coil and condenser replacements, while simple, are not recommended unless test equipment is available. Under no circumstances should any attempt be made to remove the magnetic rotor from the frame. It is locked in a special drive end thrust bearing and specific procedures must be followed in releasing the shaft.

INTERNAL TIMING

If the distributor gear has been removed for any reason, the teeth must be properly meshed with those of the magnetic rotor gear at assembly. The gear teeth are marked to facilitate the internal timing of the magneto.

NOTE: Two distributor gear teeth are marked, one for use with counterclockwise rotation and one for clockwise rotation. The unit used on this installation rotates clockwise, and the mark "C" on the gear is used for timing. The tooth on the rotor gear painted red must mesh between the two teeth of the distributor gear at point designated by the letter "C" (fig. 28).

ASSEMBLY AND SEALING

Before installing the end cap on the magneto frame, clean the contact surfaces of the cap and frame. Coat both contact surfaces with gasket cement. Using a new gasket between end cap and frame, assemble end cap to frame and secure with four screws. Tighten screws securely.

TIMING MAGNETO TO ENGINE

Proper timing of the magneto to the engine produces an ignition spark in each cylinder at the exact instant that the fuel mixture should be ignited for best engine performance. This instant on engine used with air conditioning system is top dead center - that is, with piston at the extreme top of its travel on the compression stroke. When starting the engine, however, it is desirable to retard the ignition spark until it occurs late enough in the cycle to avoid the possibility of backfiring. The impulse coupling in the magneto drive mechanism automatically provides this spark-retarding feature while the engine is being started.

The importance of correctly timing the magneto to the engine cannot be overemphasized, and

the steps described below should be followed carefully. Two methods are given, the Advance Spark Position Method and The Impulse Coupling Trip Method. Regardless of the method used, the breaker points must first be accurately adjusted.

Advance Spark Position Method

1. Magneto. Set the magneto for advance spark position in the No. 1 cylinder. This is done by turning the rotor from the coupling end in the direction OPPOSITE to that of normal operation until the distributor contact lines up exactly with the timing boss as indicated by the dotted lines in the timing diagram shown in figure 29. The magneto is now timed for advance spark position (top dead center) in the No. 1 cylinder and should be held exactly in this position until it is coupled to the engine.

2. Engine. Advance spark position (top dead center) for No. 1 cylinder is indicated on front face of engine flywheel by the line between the letters DC. Timing marks are visible through peep hole in front side of flywheel housing at right side of engine. No. 1 piston is at top dead center when the DC mark is aligned with timing pointer near peephole in housing. Piston must be on compression stroke when timing mark is aligned. To determine when piston is on compression stroke, remove No. 1 spark plug and hold thumb over opening while turning engine. Pressure will be felt when piston is on compression stroke. To turn engine manually, use screwdriver or small pry bar in flywheel teeth through peephole. Turn flywheel to align timing mark with pointer with No. 1 piston on compression stroke. With engine in this position, install magneto as directed later.

Impulse Coupling Trip Method

1. Magneto. Install end cap cover on end cap, making sure contact surfaces are clean and using gasket cement. Set the magneto for spark discharge to the No. 1 terminal as follows: Place a short piece of stiff wire in the No. 1 socket an bend end of wire to within 1/8 inch of the magneto frame. Then turn the magneto rotor from the coupling end in its normal direction of rotation until a spark is observed between the wire and the frame. Hold the coupling in the exact position at which the trip occurred.

2. Engine. Remove No. 1 spark plug to determine when No. 1 piston is on compression stroke, then turn engine until DC mark on flywheel is aligned with pointer on flywheel housing. Install magneto on engine as directed below:

COUPLING MAGNETO TO ENGINE

Without disturbing the setting of either the magneto or engine as determined by one of the methods described above, couple the magneto to the engine as follows:

Engage the drive lugs of the impulse coupling with the driving slots in the governor and magneto drive gear. A slight movement of the engine flywheel may be necessary to obtain accurate alignment. Tighten mounting bolts firmly.

IGNITION WIRING

The four cables connecting the magneto end cap cover terminals to the spark plugs carry the high voltage surges from the magneto to the spark plugs as directed by the distributor rotor. Cables should be examined at regular intervals for evidence of swollen or cracked insulation or other damage. Make sure cable ends fit firmly into end cap cover sockets and onto spark plug terminals.

MAGNETO CUT-OUT RELAY

Magneto cut-out relay (fig. 30) is mounted on air conditioning unit compartment front bulkhead. Operation of relay is described in "SYSTEM DESCRIPTION" at beginning of this group.

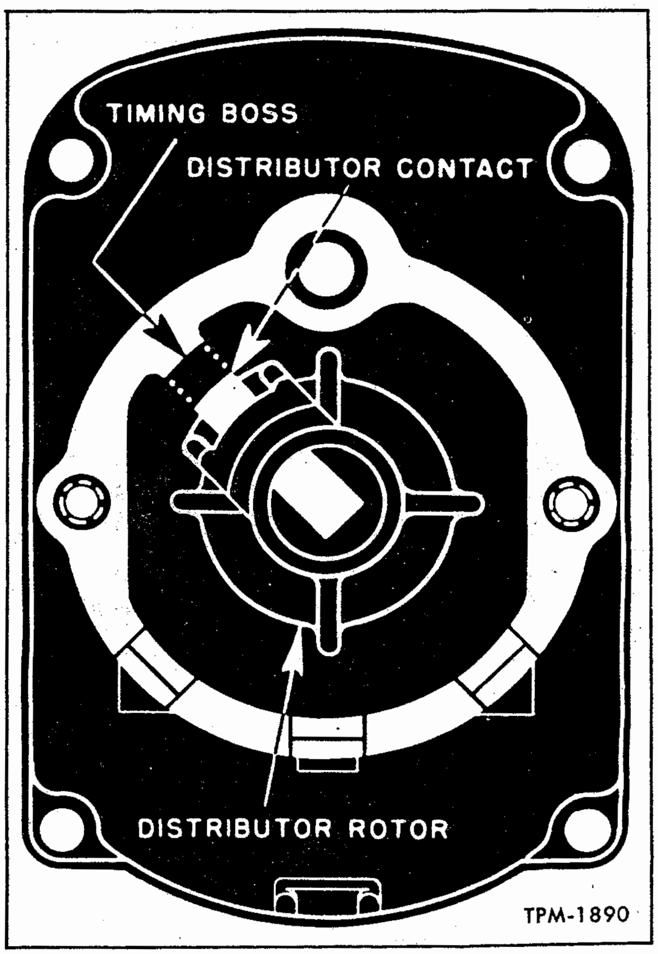


Figure 29—Magneto Timing Diagram

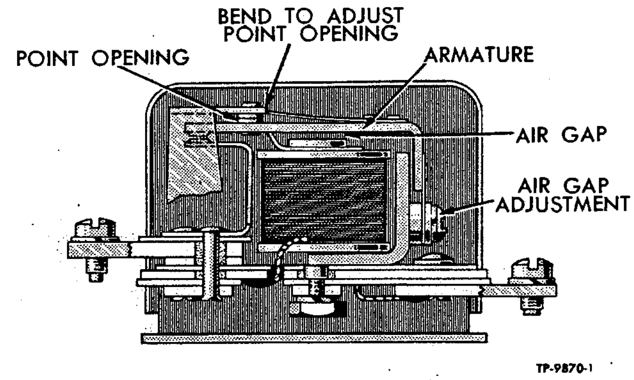


Figure 30—Magneto Cut-Out Relay (Typical)

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing and opening voltage.

Air Gap (Fig. 30)

Remove cover from relay. Depress armature against lower stop and measure air gap between armature and center of core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as required. If necessary, bend lower armature stop to obtain uniform gap between armature and core.

Point Opening (Fig. 30)

Measure point opening with armature depressed against lower stop. Adjust point opening, if necessary, by bending upper contact point support.

Opening Voltage (Fig. 30)

Connect an accurate reading voltmeter from "S" terminal to ground, and connect a variable resistance in series with the coil winding at the "S" terminal. Turn "TEST IGN" switch on compartment panel on, but do not start the engine. Adjust resistance unit and note voltmeter reading at which relay points open and close. If not within limits listed in "Specifications," adjust by bending armature spring stop to increase or decrease armature spring tension. Increasing tension increases opening voltage, and decreasing tension decreases opening voltage.

SPARK PLUGS

The spark plug is the medium through which the high voltage surge from the magneto is converted into a spark in the combustion chamber of the engine to ignite the mixture of air and gasoline. Spark plugs are subjected to severe service during operation and require the same degree of careful inspection and care as do the other units of the ignition system.

INSPECTION

At regular intervals, spark plugs should be removed and inspected for cracked porcelains, burned points, and loose terminals. Replace plugs which have excessively burned points or cracked porcelains.

Spark plugs should be cleaned with standard sandblast cleaning equipment or with the use of a cleaning solvent.

SETTING GAP

Setting spark plug gap is a precision operation and should be treated as such. Proper adjustment provides a definite clearance between side electrode and center electrode. Refer to "Specifications" at end of this group for recommended gap. When regapping is necessary, bend side electrode only; do not bend center electrode. All plugs must be set to the same dimension, using a standard round feeler gauge.

INSTALLATION

1. Use only plugs of proper type and heat range. Refer to "Specifications" at end of this group.

2. Coat spark plug threads with grease containing mica to prevent seizure in cylinder head.

3. Always use new gaskets when installing spark plugs. Place gasket over threads and turn plug into cylinder head with fingers. Be sure gasket does not drop off when positioning plug.

4. Tighten plug until it bottoms on gasket, then turn 1/4 to 1/2 turn to partially compress gasket. Do not tighten enough to crush the gasket.

5. Make sure the spark plug terminals on the wires are clean and tight, and that they are securely attached to spark plugs.

GOVERNOR AND THROTTLE

Carburetor throttle lever is connected to governor lever by an adjustable rod (fig. 31). Throttle controls are set to run engine at a constant speed of 2000 rpm, with the governor control compensating for variations in load due to changing cooling requirements.

In the centrifugal flyball type governor, which is driven by the engine gear train, two forces are utilized to obtain the desired control. The first is the centrifugal force created by the balls which tends to close the throttle as the speed of the engine increases. The second force is that of the governor lever spring, which is connected to the speed adjusting screw lever. This force is con-

stant and tends to hold the throttle in wide open position at all times. When these two forces are in equilibrium, the engine is operating at the predetermined governed speed.

When load on engine is increased due to increase in cooling requirements, the engine speed slows down and decreases the centrifugal force of the balls. The spring force, then being the greater, opens the throttle and returns the engine to governed speed.

When load on engine is reduced due to decrease in cooling requirements, the engine speed increases, causing the centrifugal force of the balls to overcome the spring force and move the throttle toward closed position until engine is again running at governed speed.

THROTTLE LINKAGE ADJUSTMENT

Throttle control adjustment must be made with compressor head pressure above 200 psi. If adjustment is made with compressor operating against lower head pressure, speed will be considerably reduced below the desired rpm when head pressure builds up to normal and increases the load on the engine. A special electric tachometer for use with magneto ignition system or a reed type tachometer can be used for checking engine speed. Adjustment is made as follows:

1. Remove cap from compressor discharge valve stem and back valve stem out (counterclockwise) to backseated position. Remove cap from tee fitting on compressor discharge valve and connect a high pressure gauge to tee. Tighten gauge line connection at tee and loosen connection at gauge. Slightly crack the discharge valve until refrigerant gas displaces air in gauge line, then tighten connection at gauge. Leave discharge valve in operating position (turned 1/2 to 1 turn away from the backseated position) (fig. 6).

2. To quickly obtain a head pressure of over 200 psi, open condenser compartment door, loosen wing nuts on condenser swing bolts and disengage swing bolts from condenser flanges, then swing condenser out. Cover condenser to prevent air flow through the condenser coils, being sure cover is secured to prevent its being drawn into the condenser fan.

3. If an electric tachometer is to be used, connect tachometer to engine ignition system. If reed type tachometer is to be used, select a surface on side of engine where tachometer base will make full contact.

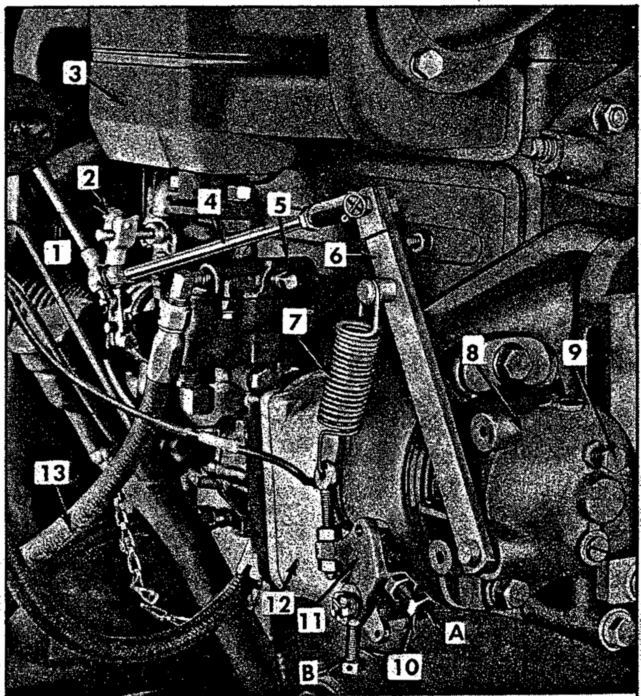
4. Make sure compressor and liquid receiver valves are in operating position. Start engine and let it run until head pressure at compressor is 215 psi.

5. If adjustment is required, loosen lock nuts on speed adjusting screws (10, fig. 31). Back screw "A" out several turns away from stop. Turn screw "B" as necessary to provide 2000 engine rpm. Turn screw "B" in to increase tension on governor lever spring and increase engine speed. Turn screw "B" out to decrease spring tension and engine speed. Tighten lock nut on screw "B" when position which provides 2000 engine rpm is obtained. Turn screw "A" in against stop and tighten lock nut.

6. Bumper screw (9, fig. 31) is used to stop hunting or surging. Screw should be turned in only enough to stop hunting or surging, but should never be turned in far enough to increase engine speed. After adjusting (if necessary), tighten lock nut on screw.

7. Shut off engine. Backseat compressor discharge valve, disconnect high pressure gauge from tee, then install cap on tee. Place valve in operating position (turned 1/2 to 1 turn away from backseated position) and install valve stem cap on valve.

8. Remove cover from condenser, swing condenser into place, and secure with swing bolts.



1 Electric Choke Link	8 Governor Assembly
2 Throttle Shaft Lever	9 Governor Bumper Screw
3 Intake Manifold	10 Speed Adjusting Screws
4 Throttle Shaft Lever to Governor Lever Rod	11 Speed Adjusting Screw Lever
5 Carburetor Assembly	12 Magneto Assembly
6 Governor Lever	13 Fuel Supply Line
7 Governor Lever Spring	

TPM-1841-1

Figure 31—Governor and Throttle Controls (Typical)

FUEL SYSTEM

Fuel system consists of the fuel tank and lines, electric fuel pump, fuel strainer, carburetor, and electric choke.

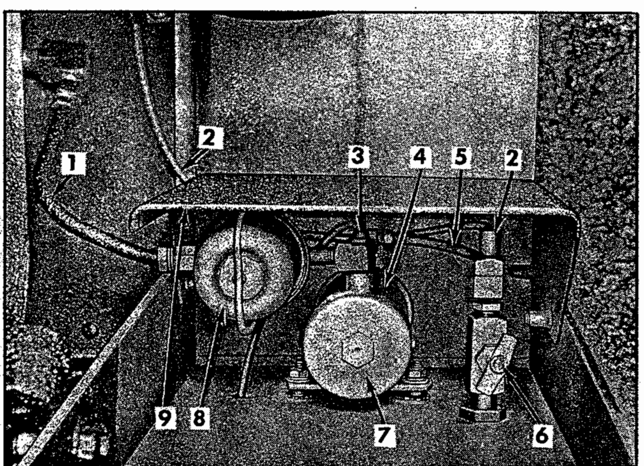
FUEL TANK

Fuel tank is mounted under floor at center of vehicle immediately behind the front axle. Fuel tank filler neck is accessible through a lift-type access door at rear of right front wheelhouse. Instructions for filling tank are included previously in "OPERATING INSTRUCTIONS" in this group.

Drain plug is provided in bottom of tank. Tank should be drained and flushed out periodically to remove any sediment which may have collected in bottom of tank. Tank should be filled at end of each day's run to reduce condensation of moisture from air in tank.

FUEL LINES

Action of fuel pump draws fuel from tank and through fuel filter into bottom of fuel pump. Fuel is discharged from top of pump into a line leading to a shut-off valve at side of fuel pump (fig. 32), through the shut-off valve, then to the carburetor. The small fuel line connected to tee fitting at shut-off valve and leading back to the top of the fuel tank is a syphon break line. Purpose of this line is to prevent fuel from syphoning out of tank through the carburetor when the vehicle is in operation with the air conditioning engine stopped.



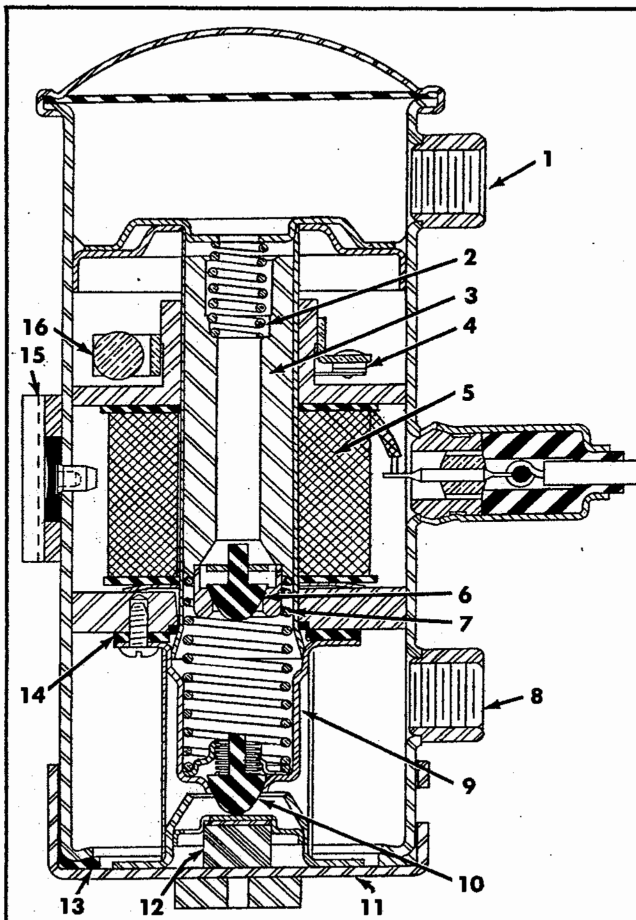
1 Inlet Line From Fuel Tank	5 Pump Outlet Line
2 Syphon Break Line	6 Fuel Shut-off Valve
3 Wiring Connector	7 Sediment Bowl Cover
4 Fuel Pump Assembly	8 Fuel Filter Assembly
	9 Fuel Pump Shield TPM-5487

Figure 32—Fuel Pump, Strainer, and Shut-Off Valve Installed

Shut-off valve should be closed when operating the vehicle for extended periods with air conditioning engine stopped. Valve should always be closed when air conditioning engine is removed from vehicle, and end of fuel line should be capped. Valve must be open when operating air conditioning engine.

ELECTRIC FUEL PUMP

Electric fuel pump (fig. 33) is mounted on bulkhead at rear of left front air suspension rear bellows as shown in figure 32. The electric fuel



1 Pump Outlet	10 Inlet Valve
2 Buffer Spring	11 Cover
3 Plunger	12 Magnetic Separator Chamber
4 Interrupter Points	13 Cover Gasket
5 Solenoid Coil	14 Plunger Spring Cup Gasket
6 Plunger Valve	15 Mounting Bracket
7 Plunger Spring	16 Condenser TPM-1322
8 Pump Inlet	
9 Plunger Spring Cup	

Figure 33—Fuel Pump Assembly

pump is designed with a solenoid, which when energized, activates a hollow plunger. The stroke of the plunger is controlled by a set of interrupter points in the electrical circuit and by the calibrated plunger spring. The interrupter points and condenser are sealed in helium, and consequently cannot be serviced. If any of the electrical components become inoperative, the complete pump should be replaced.

The up and down movement of the hollow plunger and the action of the two check valves causes gasoline to be drawn from the pump bottom chamber up through the hollow plunger into the upper chamber. Fuel line leading to engine carburetor is connected to outlet opening in upper chamber.

The pump should always be installed with the end stamped "TOP" up. The pump electrical circuit is grounded through its mounting bracket. When installing pump, make sure all paint is removed from the mounting surface to assure a good ground. Also make sure unit is designed for 12 volt, positive ground system as indicated by stamping on mounting bracket.

Normally, the only service required is to occasionally clean the sediment bowl cover at the bottom of the pump. However, the plunger spring cup and plunger assembly can be removed for cleaning or replacement.

CLEANING SEDIMENT BOWL COVER AND SCREEN

NOTE: Key numbers in text refer to figure 33.

This operation can be accomplished without removing the fuel pump from the vehicle.

1. Remove the sediment bowl cover (11), using a wrench on nut attached to cover. Usually the screen comes off with the cover, although it may occasionally stick to the plunger spring cup.
2. Carefully remove screen and flush it in gasoline or kerosene to remove all foreign particles. If screen is badly distorted or collapsed, replace with new screen.
3. Clean the cover in the same manner, then apply air pressure to remove any foreign particles which may have accumulated in the small magnetic separator chamber in center of cover. Inspect cover gasket (13), if gasket will not form a perfect seal, replace with new gasket.
4. Install screen in place in cover, then carefully guide the screen around the plunger spring cup. Use a wrench on nut at bottom of cover to turn cover to fully closed position.

NOTE: Check the rim of the cover for fuel leaks when pump is first operated after cleaning. If a leak appears, install a new cover gasket.

CLEANING PUMP PLUNGER AND VALVES

NOTE: Key numbers in text refer to figure 33.

Pump assembly must be removed from vehicle to accomplish this operation.

1. Remove bolts attaching fuel pump shield to body structure and remove shield (fig. 32).
2. Disconnect harness wire from fuel pump lead. Disconnect fuel lines from elbows and fuel filter on pump. If a new pump is to be installed, remove elbow and fuel filter from old pump for installation on replacement unit. Remove nut and lock washer from two pump mounting bolts, then remove pump assembly.
3. Mount pump in vise, clamping vise jaws onto one side of the mounting bracket. Remove sediment bowl cover (11) and screen, using wrench on nut at bottom of cover.
4. Remove three screws securing plunger spring cup (9) in fuel pump body. Remove plunger spring cup, gasket (14) plunger spring (7) and plunger and valve assembly (6) from pump body. The buffer spring (2) or the valve assembly should never be removed from the plunger. Also, do not remove valve assembly (6) from the plunger spring cup.
5. Rinse the plunger assembly and the plunger spring cup assembly in gasoline or kerosene. Make sure all particles of foreign material are removed from between the valves and seats. Do not apply air pressure to dry the parts. Wipe inside of cylinder out with a clean, lint-free cloth.
6. Insert the plunger (3) and valve assembly (6) with buffer spring (2) into the cylinder, buffer spring end first. Check fit of plunger (3) in cylinder by slowly raising and lowering the plunger in the cylinder. It should move freely without any tendency to stick. A click will be heard each time the plunger approaches the top of the cylinder, thus indicating that the interrupter system is functioning properly.
7. Install plunger spring (7), plunger spring cup gasket (14), and plunger spring cup (9), and valve assembly (10) and attach with screws. Tighten screws reasonably tight, but not tight enough to distort the cup.
8. Install sediment bowl cover (11) screen, and gasket (13) and turn into place using wrench on nut at bottom of cover.
9. Install pump assembly on vehicle with end stamped "TOP" up, making sure mounting bolts and bracket are clean to assure a good electrical ground. Install nut and lock washer on each mounting bolt and tighten firmly.
10. Connect fuel filter and fuel lines to fuel pump and connect harness wire to fuel pump lead. Install fuel pump shield and attach with three bolts.

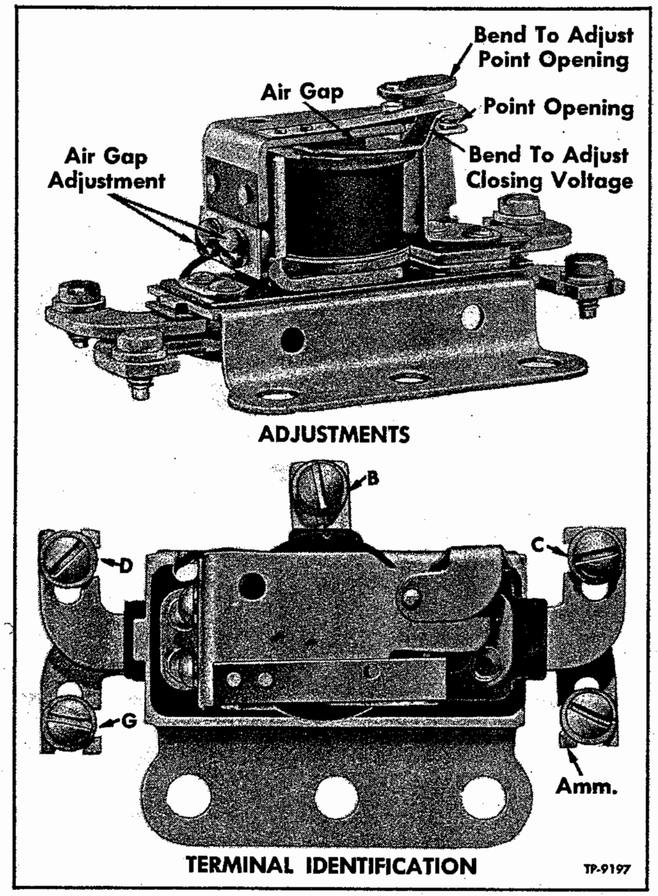


Figure 34—Fuel Pump Relay

FUEL PUMP RELAY

Fuel pump relay is mounted on air conditioning compartment front bulkhead. Operation of relay is described in "SYSTEM OPERATION" of this section.

ADJUSTMENTS

Refer to "Specifications" at end of this group for air gap and point opening dimensions and for closing voltage.

Air Gap (Fig. 34)

Remove cover from relay. Press armature down until lower points just close and measure air gap between armature and core. Adjust air gap, if necessary, by loosening two screws and moving armature up or down as necessary. If necessary, bend lower contact support so the air gap will be uniform across top of core.

Point Opening (Fig. 34)

Measure point opening between lower contacts with upper contacts closed. Adjust point opening, if necessary, by bending the upper contact support.

1 Strainer Head
2 Gasket
3 Strainer Element
4 Strainer Bowl
5 Bail and Nut

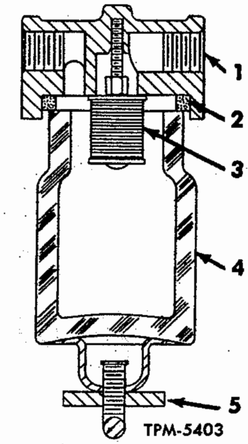


Figure 35—Fuel Strainer Assembly

Closing Voltage (Fig. 34)

NOTE: Terminals marked "AMM" and "B" in figure 34 marked in same manner on relay. Other terminals, identified as "C," "D," and "G" in figure 34 are not marked.

Connect an accurate reading voltmeter in parallel with the coil winding from terminal "D" (fig. 34) to ground. Connect a variable resistance in series with the coil winding at the "D" terminal. Place heating and cooling "MASTER SWITCH" in "COOLING" position. Slowly decrease resistance until lower contacts close and note reading on voltmeter. If not within range listed in "Specifications," adjust by bending the armature spring post to increase or decrease spring tension. Increasing spring tension decreases closing voltage.

FUEL STRAINER

A fuel strainer (fig. 35) is connected into the fuel line near the fuel pump (fig. 32). Strainer assembly incorporates an edge type strainer element which cleans the fuel before it reaches the fuel pump and carburetor, providing the strainer element is given the proper maintenance. Gasoline enters through the inlet and fills the bowl, then passes between the strainer discs which remove dirt, rust, etc. The clean fuel then flows up through spaces in center of strainer element and out the outlet to the pump and carburetor. Service the strainer at regular intervals as follows:

1. Loosen bail nut until bail can be swung aside, then remove strainer bowl and empty the contents.

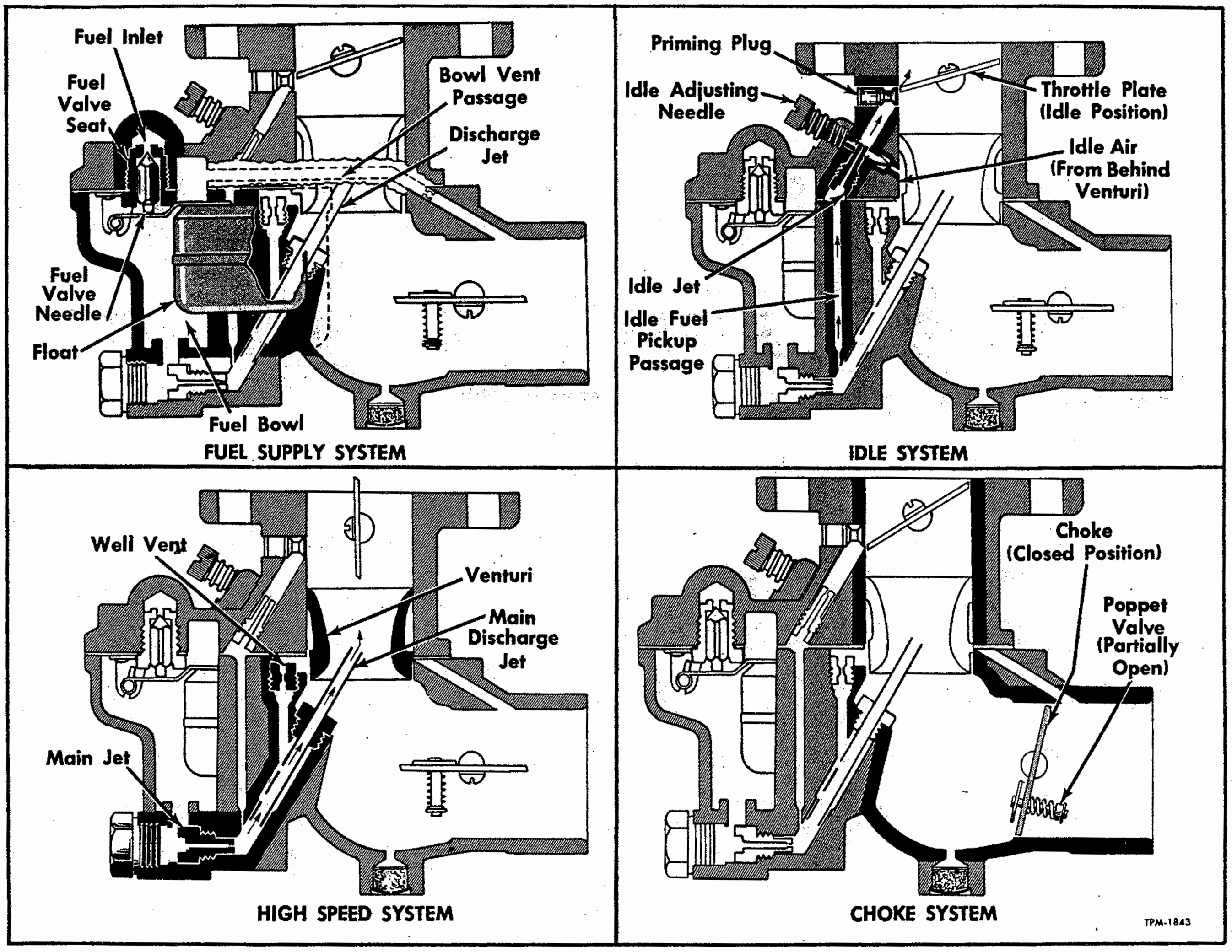


Figure 36—Carburetor Operation

2. Carefully unscrew the strainer element from the strainer head.

3. Wash strainer element and bowl in clean gasoline. If the accumulated dirt is gummy, it may be necessary to brush the strainer element lightly. Use compressed air lightly to blow small particles of dirt from between the strainer element discs.

4. Install strainer element under strainer head, making sure it is securely tightened. Install glass bowl, making sure gasket is in good condition, position bail under bowl, and tighten bail nut.

CARBURETOR

Updraft type carburetor (fig. 36) is mounted on intake manifold at right side of engine as shown in figure 37. Air is supplied to air intake at bottom of carburetor from oil bath type air cleaner through a hose. A drip shield is mounted below carburetor above ignition spark plug cables.

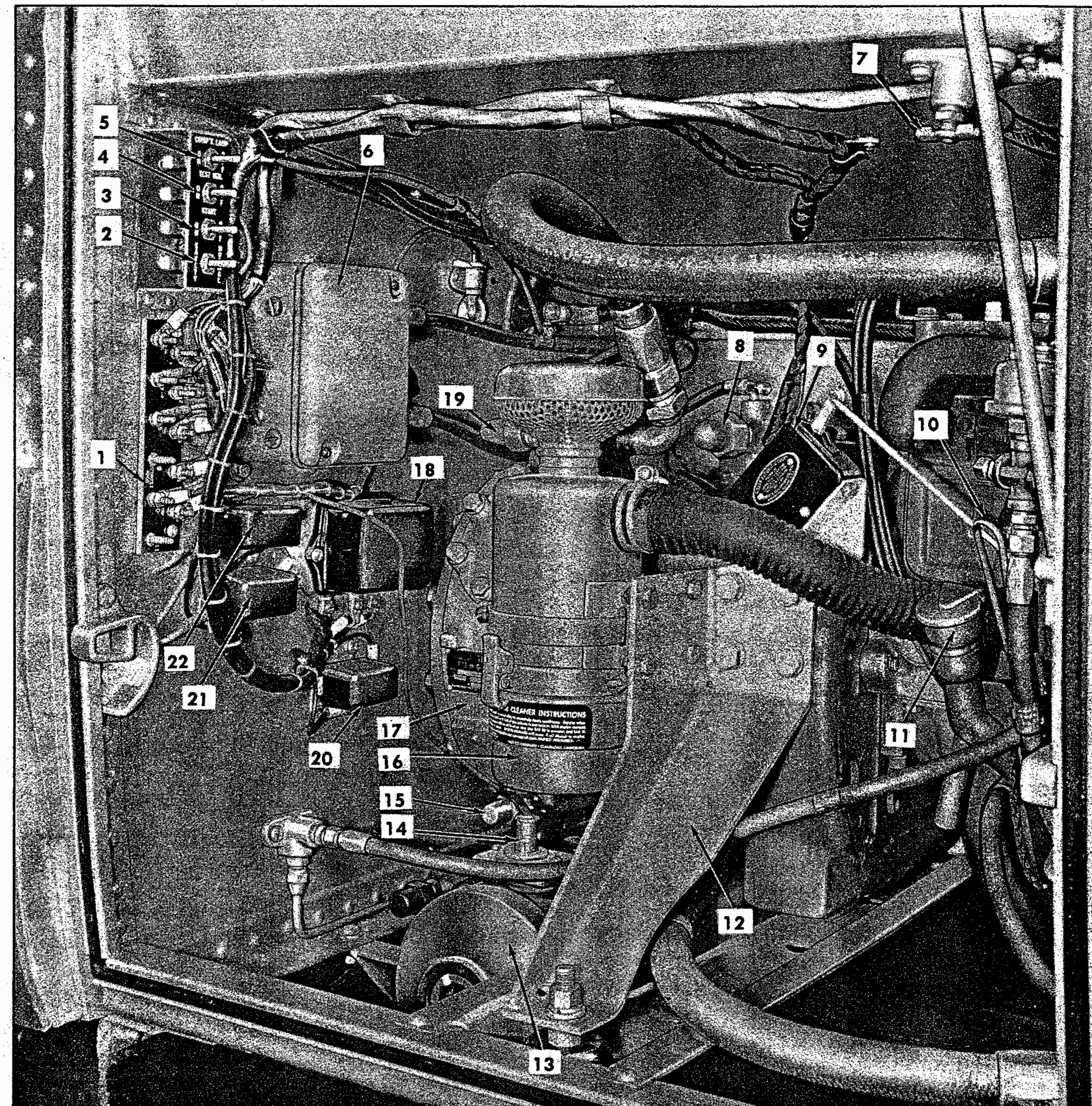
OPERATION (Fig. 36)

Fuel Supply System

The fuel supply system consists of the threaded fuel inlet, the fuel valve seat, fuel valve, float, and fuel bowl.

The fuel supply line is connected to the threaded inlet. The fuel travels through the fuel valve seat and passes around the fuel valve and into the fuel bowl. Level of fuel in fuel chamber is regulated by the float through its control of the fuel valve. The fuel valve does not open and close alternately but assumes an opening, regulated by the float, sufficient to maintain a proper level in the fuel chamber equal to the demand of the engine.

The inside bowl vent as illustrated by the passage originating in the air intake and continuing through to the fuel bowl, is a method of venting the fuel bowl to maintain proper air-fuel mixtures even through the air cleaner may become restric-



1 Junction Block
2 Safety Switch
3 Starter Switch
4 Test Ignition Switch
5 Compartment Light Switch
6 Hi-Lo Pressure Switch
7 Cooling System Vent Cock
8 Compressor Suction Valve
10 Engine Oil Dipstick
11 Engine Oil Filler
12 Engine Rear Support Bracket
13 Liquid Receiver Tank
14 Liquid Receiver Sight Glass Light
15 Compressor Drain Valve
16 Engine Air Cleaner
17 Compressor
18 Auxiliary Generator Regulator (Some Coaches)
19 Compressor Discharge Valve
20 Auxiliary Generator Control Relay (Some Coaches)
21 Magneto Cut-out Relay
22 Fuel Pump Relay TPM-5491

Figure 37—Engine Compartment

ted. This balancing is frequently referred to as an "inside bowl vent."

Idle System

The idle system consists of the idle discharge port, idle air passage, idle adjusting needle, idle jet, and fuel passage. The idle system functions only when the throttle rod is disconnected from the governor lever, as when operating engine at idle speed for engine tune-up.

Fuel for idle is supplied through the main jet to a well directly below the main discharge jet. The pick-up passage is connected to this well by a restricted drilling at the bottom of this passage. The fuel travels through this channel to the idle jet calibration. The air for the idle mixture originates back of (or from behind) the main venturi. The position of the idle adjusting needle in this passage controls the suction on the idle jet and thereby the idle mixture. Turning the needle in closer to its seat results in a greater suction with a smaller amount of air and therefore a richer mixture. Turning the needle out away from its seat increases the amount of air and reduces the suction, and a leaner mixture is delivered. The fuel is atomized and mixed with the air in the passage leading to the discharge port (or priming plug) and enters the air stream at this point.

High Speed System

The high speed system controls the fuel mixture at part throttle speeds and at wide open throttle. This system consists of a venturi, controlling the maximum volume of air admitted into the engine; the main jet, which regulates the flow of fuel from the float chamber to the main discharge jet; the well vent, which maintains uniform mixture ratio under changing suction and engine speeds; and the main discharge jet, which delivers the fuel into the air stream.

The main jet controls the fuel delivery during part throttle range from about one-quarter to full throttle opening. To maintain a proper mixture ratio, a small amount of air is admitted through the well vent into the discharge jet through the air bleed holes in the discharge jet at a point below the level of fuel in the metering well.

The fuel flows from the fuel chamber through the main jet and into the main discharge jet where it is mixed with air admitted by the well vent, and the air-fuel mixture is then discharged into the air stream of the carburetor.

Choke System

The choke system consists of a valve mounted on a shaft located in the air entrance and operated externally by a lever mounted on the shaft. The choke valve is used to restrict the air entering the carburetor. This increases the suction on the jets when starting the engine. The choke valve is of a "semi-automatic" type, having a poppet valve incorporated in its design which is controlled by a spring.

The poppet valve opens automatically when the engine starts and admits air to avoid over-choking or flooding the engine. The mixture required for starting is considerably richer than that needed to develop power at normal temperatures. As the engine fires and speed and suction are increased, the mixture ratio must be rapidly reduced. This change is accomplished through the automatic opening of the poppet valve to admit more air when the engine fires.

CARBURETOR ADJUSTMENTS

All mixture adjustments, other than idling, are determined by calibration of jets and can only be changed by disassembling carburetor and installing different jets. Sizes of jets should not be changed unless recommended by factory service department. When replacing parts, use parts stamped with same number as parts which were removed.

To adjust idling speed and mixture, disconnect throttle rod from governor lever and adjust the idle stop screw in throttle shaft lever to obtain the desired idling speed. Adjust idle adjusting screw in carburetor throttle body to obtain highest engine speed. If engine runs too fast after adjustment, re-adjust the idle stop screw.

FUEL LEVEL

Fuel level may be checked by removing carburetor and disassembling throttle body from bowl. Inspect fuel valve and replace if necessary.

Invert throttle body and make sure fuel valve is seated. Move gasket to one side. Measure from gasket surface of throttle body to top of float. Dimension should be 1-5/32 inches, plus or minus 3/64 inch. Bend float arm as necessary to obtain this dimension. Replace with new float if position is off more than 1/16 inch.

CARBURETOR OVERHAUL

Carburetor should be removed and overhauled at engine overhaul periods, using parts contained in carburetor repair kit.

ELECTRIC CHOKE

Choke, mounted on right side of engine (fig. 37), is an electrically operated choke, but is not an automatic choke. Choke is controlled only by the "CHOKE" button on driver's control panel, but may be operated manually when starting the engine from the air conditioning engine compartment. Choke operation is not affected by manifold vacuum or by engine temperature.

ADJUSTMENT

Electric choke arm is connected to carburetor choke valve by an adjustable link. Length of link is adjusted by removing pin from carburetor choke lever, then turning clevis on link. Adjust link so that carburetor choke valve is wide open with electric choke arm raised to top limit. Tighten lock nut against clevis when adjustment is completed. When solenoid circuit is completed at the "CHOKE" button, choke arm moves down, closing the choke valve in carburetor.

AIR INTAKE SYSTEM

Air intake system consists of the oil bath type air cleaner and intake hose (fig. 37). All air for combustion in the engine passes through the air cleaner, then to the carburetor through the hose. Since engine produces a suction, leakage at any point will permit unfiltered air to enter engine. Keeping hose clamps tight is important.

AIR CLEANER

Air cleaner is an oil bath type cleaner which requires regular inspection and service. Air enters through screen intake on top of cleaner, then passes downward through the tube to bottom of cleaner. Air inlet is submerged in oil and maintains a vortex action in cleaner. Design of edges prevent uncovering air inlets at low oil levels.

MAINTENANCE

Air cleaner should be serviced daily or more often in extremely dusty conditions and whenever engine oil is changed. Cleaner should also be inspected frequently and serviced when oil thickens or if 1/2 inch of dirt is collected in bottom cup.

To service air cleaner, disengage two latches and remove the bottom cup. With fingers, dislodge and remove disc-shaped pre-filter from cleaner. Other filter element in top of cleaner serves as an oil eliminator and need not be cleaned or replaced. Wash pre-cleaner and cup in gasoline to remove all foreign matter. Install pre-filter in cleaner. Fill cup to mark with engine oil, using the same oil recommended for use in engine crankcase in "LUBRICATION" later in this group. Position cup at bottom of cleaner and secure with two latches. Make sure intake screen at top of cleaner is not clogged.

ENGINE COOLING SYSTEM

The air conditioning engine cooling system consists of the engine water pump, radiator, thermostat, and Alarmstat. The condenser fan is also a part of the engine cooling system in that it circulates air through the engine radiator.

The cooling system obtains its coolant from the coach heating system heater supply line; but still functions independently of the coach engine cooling system. Shut-off valve provided in supply line and in radiator vent line at top of radiator (fig. 38) permits draining the air conditioning engine cooling system without draining the coach heating system. Valves must always be open when air condition system is operating. A vent line from engine water pump outlet is connected to a vent cock mounted on air conditioning engine compartment ceiling at outer edge.

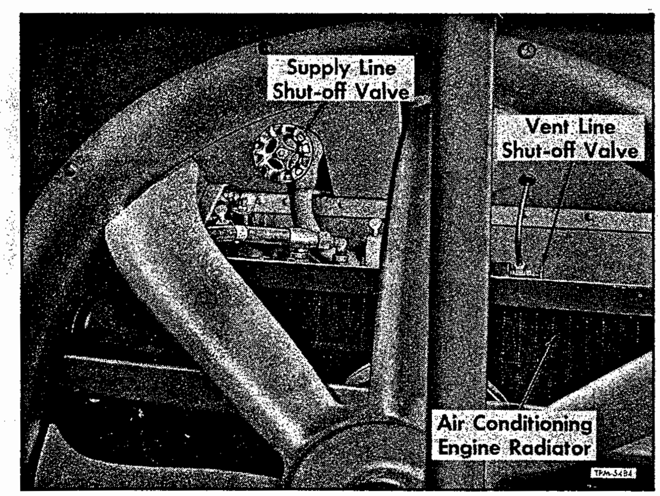


Figure 38—Location of Supply and Vent Line Shut-Off Valves

Water pump, driven by belt from the crankshaft pulley, circulates coolant from radiator through engine water passages, then back to radiator where it is cooled by the action of the condenser fan. Engine thermostat, mounted in cylinder head at engine water outlet, restricts flow of water to radiator until a predetermined temperature is reached, thus reducing the time required to reach an efficient operating temperature.

INSPECTION OF SYSTEM

Since action of cooling system controls operating temperature of engine, it is logical to assume that the cause of an overheated engine lies in the cooling system; however, late ignition timing or improper or insufficient lubricating oil in engine crankcase will cause engine to overheat, even though the cooling system is functioning properly.

Systematic and periodic inspection of units in cooling system is essential to maintain efficiency of system. Inspect at regular intervals as follows:

1. Check condition of all hose connections. Tighten hose clamps if necessary. Cracked or swollen hose should be replaced.
2. Check radiator core for leaks. Make certain that core is not clogged with dirt or insects. Blow radiator core out with low air pressure from inner side.
3. Repair all leaks in system. One drop of solution lost each ten seconds amounts to nearly one gallon in a week.
4. Test action of thermostat and replace if necessary.

SERVICING COOLING SYSTEM

Instructions for filling, bleeding, and draining air conditioning cooling system are explained in the "HEATING AND VENTILATION" (SEC. 3). Cooling system which is interconnected and supplied by the coach heating system should be serviced in conjunction with the heating system.

Air conditioning supply and vent line shut-off valves are located behind condenser fan as shown in figure 38. Air conditioning engine cylinder block and radiator drain cocks are located as shown in figure 39.

Cooling system should be vented while running engine by opening vent cock (7, fig. 37) on compartment ceiling. Close vent cock when coolant flows from vent cock in a solid stream. Refill main engine cooling system as required.

RADIATOR

Radiator is of conventional fin and tube type construction, mounted at inner side of condenser compartment. Coolant in tubes transfers heat to fins, where heat is removed by air blown through core by condenser fan.

Radiator air passages should be blown out with compressed air whenever condenser is cleaned. At engine overhaul periods, remove radiator and clean inside and out in cleaning solution. Examine core for leaks and bent fins, and repair if necessary. If radiator core requires painting, spray with special radiator paint; do not use an oil-base paint as this type of paint will form an insulation on core and prevent efficient dissipation of heat.

A damaged or clogged radiator should be taken to a radiator repair shop or replaced with a new one. Efficient repair of damaged radiator requires use of special tools and equipment, as well as facilities for making tests.

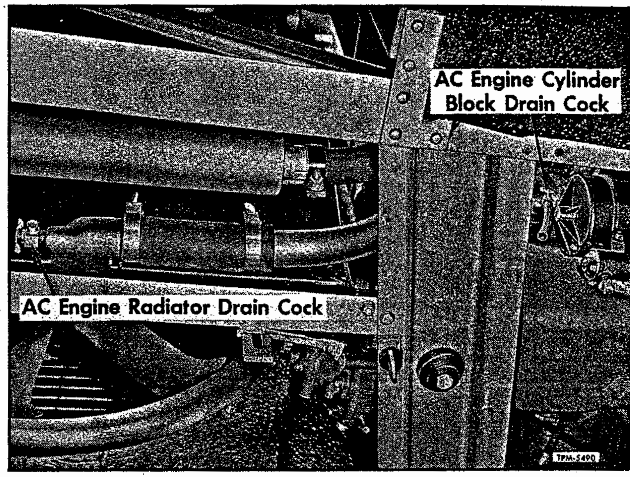


Figure 39—Location of Cylinder Block and Radiator Drain Cocks

ENGINE THERMOSTAT

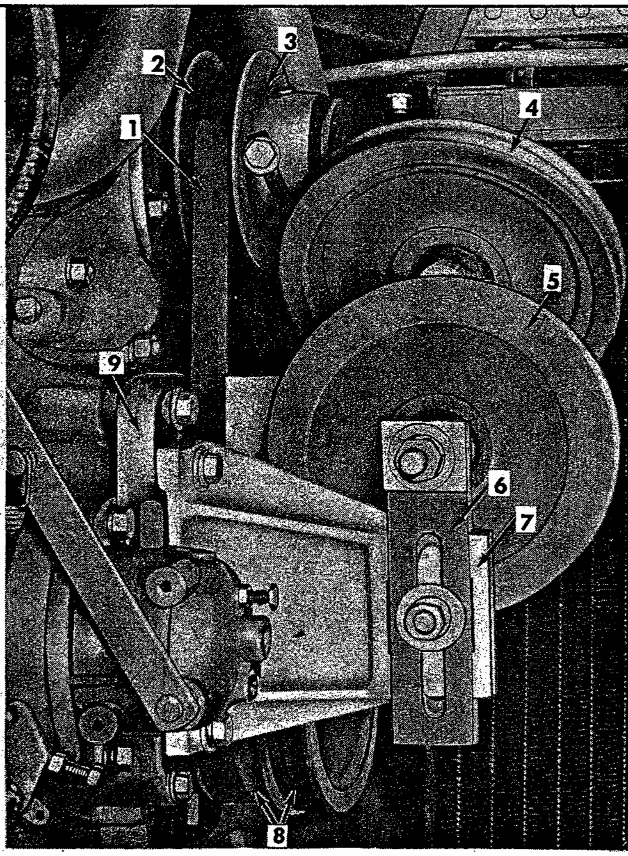
Engine thermostat, contained in thermostat housing on top of engine cylinder head, consists of a restriction valve actuated by a thermostatic element. Thermostat valve cracks or just starts to open at a predetermined temperature and continues to open in gradual stages as engine temperature increases. Opening temperatures are listed in "Specifications" at end of this group.

The thermostat is a delicately constructed instrument and should be handled accordingly. If thermostat is not functioning properly, remove assembly and test in water, gradually brought up to operating temperature by heating, and then in water at fully closed temperature. Thermostatic element should be completely submerged and water agitated thoroughly when taking temperature readings. Do not attempt to repair thermostat. If it does not function properly, install a new thermostat which has been checked as directed above. Install thermostat so that "Front" stamped on flange is facing front of engine. Use new gasket between water outlet and cylinder head.

ENGINE ALARMSTAT

Engine Alarmstat, mounted in left side of engine cylinder head, incorporates a thermostatically controlled switch connected between the magneto and ground. When engine becomes overheated, thermal element in Alarmstat causes contacts to close; with contacts closed, magneto circuit is grounded, stopping engine.

Alarmstat is identical to the unit used as a "Water Overheat Thermostat" in the vehicle engine, except that the points close at 230°F. Refer to COOLING SYSTEM (SEC. 6) for service instructions which will apply.



1 Water Pump Drive Belt	6 Adjusting Idler Pulley Slider
2 Water Pump Pulley Hub	7 Adjusting Idler Pulley Bracket
3 Water Pump Pulley Adjusting Flange	8 Crankshaft Pulley
4 Condenser Fan Belt Idler Pulley	9 Idler Pulley Bracket
5 Condenser Fan Belt Adjusting Idler Pulley	

TPM-1842

Figure 40—Condenser Fan and Engine Water Pump Drive

WATER PUMP DRIVE BELT

Water pump is driven by V-belt from engine crankshaft pulley (fig. 40). Water pump pulley, consisting of a hub and an adjusting flange, is mounted on water pump shaft. Adjusting flange is attached to hub by two bolts which pass through spiral slots in the flange. Belt adjustment is made by means of these spiral slots. With attaching bolts loosened, adjusting flange can be turned, increasing or decreasing the depth of the belt groove in the pulley, thus changing belt tension. Adjusting flange bolts must be firmly tightened after adjusting belt tension.

BELT REPLACEMENT (Fig. 40)

1. Remove stone shield from under condenser compartment. Belts and pulleys can be reached from between the condenser fan shroud and the engine radiator.

2. Loosen bolt securing condenser fan adjusting idler pulley slide in bracket. Move adjusting pulley and slide down to permit removing condenser fan belt. Remove condenser fan belt.

3. Loosen three bolts attaching idler pulley bracket in front of engine. Remove two bolts attaching water pump belt adjusting flange to drive hub. Remove adjusting flange from hub, moving condenser fan idler pulley bracket away from engine to permit removal of flange. Remove old water pump drive belt (if still in place).

4. Position new water pump belt on crankshaft pulley and on water pump drive hub. Install adjusting flange on hub and secure with two bolts. Adjust flange to provide proper belt tension, then tighten attaching bolts firmly. (Correct belt tension is when a light pressure on belt midway between pulleys will cause 1/2 inch deflection in belt.)

5. Tighten the three bolts attaching condenser fan idler pulley bracket to front of engine.

6. Install condenser fan drive belt in pulleys and adjust belt tension by means of the adjusting idler pulley. Adjust to conventional V-belt tightness.

OIL FILTER

Oil filter is provided with a removable filtering element which should be discarded and replaced with a new element at regular intervals. Oil filter is so designed that it will effectively retard contamination of engine oil if given proper maintenance.

MAINTENANCE

The most positive assurance of continuous and efficient functioning of oil filter is inspection and replacement of filtering element at regular intervals. The filtering element changing periods are directly related to oil changing periods, type and quality of oil used, severity of and type of engine operation. Therefore it is impossible to recommend a definite period that will meet all types of service, other than the recommendation in "LUBRICATION AND INSPECTION" in this group.

In view of the foregoing, it is recommended that frequent inspections be made of engine oil to determine advisable intervals between engine oil and oil filter element changes. In some types of service where operating conditions are severe, laboratory tests, conducted by the oil supplier or by another suitable laboratory, of oil drained from

engine may be helpful in determining greatest advisable intervals between engine oil and oil filter element changes for a specific operation.

Use only genuine element when replacement is necessary. It is recommended that new cover gasket always be replaced when element is replaced.

Solid matter and water settle to lower portion of filter, and should be drained at regular intervals by removing drain plug. If filter is drained completely, as when element is renewed, add sufficient oil to crankcase to bring oil to correct level.

While oil filter will adequately remove dust and dirt from oil, the element must be removed before becoming clogged. Vehicles operating in dusty areas require renewals more often than those which do not encounter such condition.

Removal of Filter Element

Before taking off filter cover, remove plug in filter base, allowing oil to drain from filter. Remove cover nut and lift cover gasket and spring from body. Remove element.

LOW OIL PRESSURE SWITCH

Low oil pressure switch is connected to engine pressure lubrication system at oil filter inlet. Switch circuit is fed through the "COOLING" side of the driver's "MASTER SWITCH" or through the compartment control panel "TEST IGN." switch. Refer to Wiring Diagram (fig. 2) for electrical connections. Operation of switch is previously explained in "SYSTEM OPERATION" of this group.

Low oil pressure switch requires no maintenance. In the event the "COOL-LOW OIL" tell-tale fails to illuminate when "MASTER SWITCH" is placed in "COOLING" position, a simple test can be made to determine if switch is faulty. Short across switch terminals with a jumper wire. If tell-tale lights, switch is defective and must be replaced. If tell-tale does not light, trouble is elsewhere in circuit, probably due to a burned out tell-tale bulb.

OIL PRESSURE

Oil pressure gauge can be connected to low oil pressure tee fitting at oil filter inlet. Oil pressure should be 30-40 psi at normal operating speed of 2000 rpm, with recommended grade of oil in crankcase.

STARTING SYSTEM

Starting system includes starter switches, starter magnetic switch, starting motor, and wiring. Refer to Wiring Diagram in back of manual for wiring connections.

STARTING MOTOR

Starting motor, mounted on left side of engine, is a 12-volt starter with Bendix "Folo-Thru" type drive. Starter is a four pole, four brush unit with three field coils wound in series and one in shunt. Brush holders are mounted in field frame. Magnetic switch is mounted on field frame with one of the switch terminals extending through an insulator in the field frame. Field coil lead is connected to the switch terminal inside the field frame. Commutator end frame, center bearing, and drive end housing are equipped with bushings. Starter requires no periodic lubrication.

"Folo-Thru" Drive

Externally, the "Folo-Thru" drive (fig. 41) is similar in appearance to the conventional barrel type drive, and is installed on armature shaft with Woodruff key and locating screw.

The "Folo-Thru" drive assembly is designed to overcome demeshing of the drive pinion from the flywheel teeth until a predetermined engine speed is reached. Automatic meshing of the drive pinion with the flywheel ring gear teeth is accomplished in the usual manner by closing the starter switch and the drive then cranks the engine. If the engine fails to continue running due to weak or irregular firing, demeshing of the drive pinion from the flywheel teeth is prevented. Cranking is automatically resumed immediately after the speed of the overrunning parts of the drive reaches that of

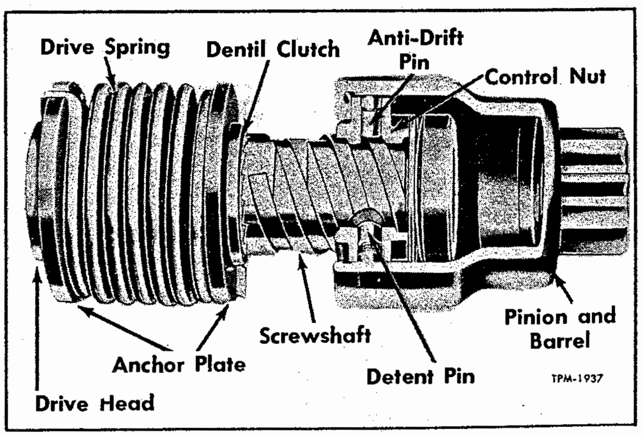


Figure 41—Starting Motor Drive

the starter armature shaft.

The "Folo-Thru" drive is serviced only by replacing the complete drive assembly. Drive is removed from armature shaft by removing locating screw and sliding assembly off the shaft. Before installing a new drive assembly, make sure armature shaft is thoroughly clean, then coat armature shaft with light engine oil. Make sure Woodruff key is in place in shaft and that locating screw hole in drive shaft is aligned with screw seat in armature shaft. Install locating screw and tighten firmly.

NOTE: If the pinion and barrel assembly is accidentally rotated manually to the fully extended position on the screwshaft during installation, do not attempt to force it in reverse direction. Proceed to install the drive in extended position. When the engine starts, the centrifugal force automatically demeshes the drive pinion from the flywheel teeth in the usual manner and the drive will return to the fully demeshed position.

CONDENSER AND RADIATOR FAN AND DRIVE

Condenser and radiator fan is mounted between the condenser and radiator, enclosed by a shroud to control air flow. Fan draws air in through condenser coils and exhausts it through the engine radiator and out under the vehicle. Fan is driven by belt from the engine crankshaft pulley through a right-angle drive arrangement as shown in figure 40. A plan view of the drive arrangement is shown in figure 1.

Fan shaft is mounted in two bearings which are equipped with lubrication fitting (figs. 42 and 43). Bearings should be lubricated at intervals explained later in "Lubrication and Inspection."

Idler pulleys are mounted on permanently lubricated sealed bearings. Bearings are retained in pulleys and on pulley shafts by snap rings. One idler pulley is mounted on a vertical slider to provide belt tension adjustment.

BELT ADJUSTMENT

Idler pulley should be adjusted to provide enough belt tension to prevent slippage, but not enough to impose excessive strain on fan bearings.

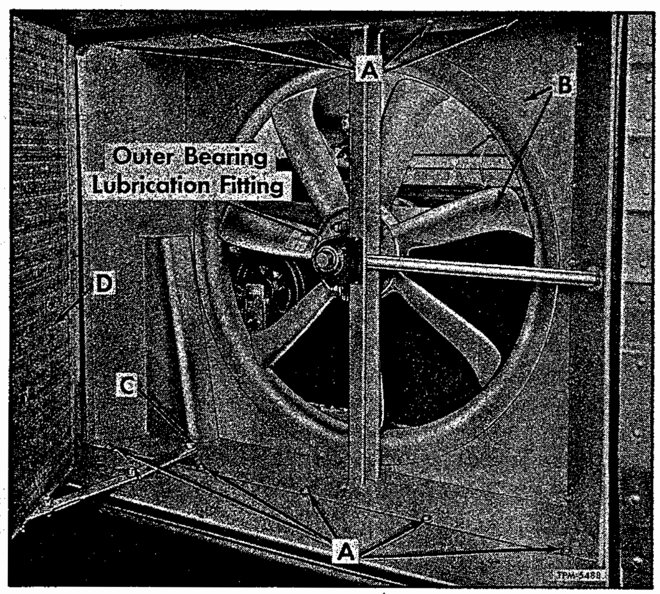


Figure 42—Condenser Disconnect Points and Fan Outer Bearing Lubrication Fitting

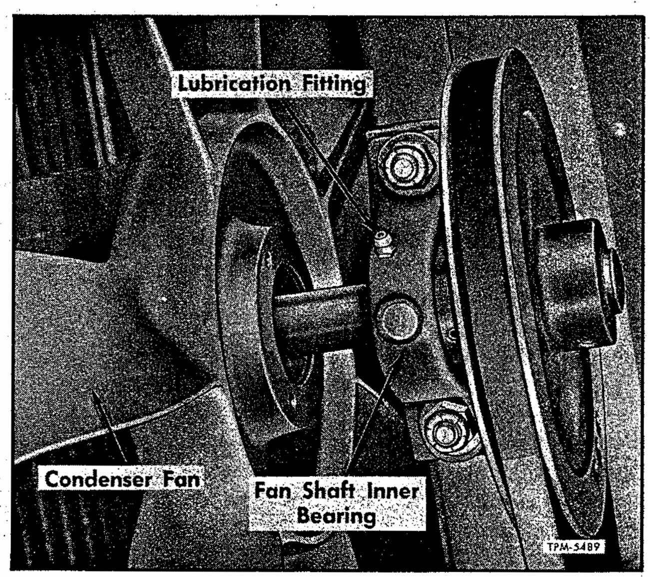


Figure 43—Condenser Fan Inner Bearing Lubrication Fitting Location

System Tests and Services

COMPRESSOR REMOVAL

NOTE: Compressor can be readily separated from the engine and removed from compartment without having to remove the engine. However, engine must be moved rearward approximately 2 to 3 inches and supported in this position. Before removing compressor, pump down system as directed later under "Pumping Down the System." Procedure for removing the compressor only is as follows:

REMOVAL PROCEDURE

1. Remove engine air cleaner from engine rear support bracket.
2. Close fuel supply shut-off valve (fig. 32), then disconnect flexible fuel line hose at carburetor or from fitting on bulkhead.
3. Pull receiver light bulb, wire and socket from receiver receptacle. Position to one side.
4. Close suction and discharge valves, then disconnect hi-lo pressure switch lines from compressor discharge and suction valves. Seal ends of lines and line fittings at compressor with tape.
5. At discharge valve, disconnect refrigerant hose flared nut from valve connector. Tape openings.
6. At suction valve, remove two bolts which attach the suction valve to compressor housing. Remove and discard valve housing gasket. Tape openings.
7. Remove bolts from three engine mountings then carefully move engine and compressor rearward approximately 2 to 3 inches and at same time cock unit to cause compressor end to be accessible. NOTE: It may be necessary to drain engine cooling system and disconnect water hoses to radiator. Instructions for draining cooling system are explained in "HEATING AND VENTILATION" (SEC. 3).
8. Remove bolts and washers which attach compressor housing to engine flywheel housing. Carefully move compressor forward to discharge drive coupling then remove compressor from compartment.
9. Remove bolt and bolt plate which attaches the compressor flywheel to compressor shaft. Remove flywheel and flywheel drive key from shaft.
10. Compressor can be overhauled as explained previously under "Compressor Overhaul."

INSTALLATION PROCEDURE

1. Install compressor flywheel on compressor shaft with drive key in position in slot of shaft. Secure flywheel to shaft with bolt and bolt plate. Tighten bolt to 55 ft.-lbs. torque.
2. Position compressor assembly to engine and engage studs of compressor flywheel into bushings of engine flywheel. Attach compressor housing to engine flywheel housing with bolts and washers. Tighten bolts evenly and firmly.
3. Position engine and compressor forward to installed position. Install engine mountings (fig. 44).
4. If suction and discharge valves were separated from compressor housing, install valves to housing ports using new gaskets. Tighten attaching bolts evenly and firmly. If refrigerant discharge hose and suction line were disconnected from valves at flared nut connections, place new O-ring seal in groove of line connection, coat ring with compressor oil, then tighten connection nut firmly.
5. Connect high-low pressure switch lines to compressor valves.
6. Install light and socket into fluid receiver recepticle.
7. Connect fuel line to carburetor or fitting on bulkhead. Open line shut-off valve.
8. Install engine air cleaner to engine support bracket.
9. Connect or attach any other parts which may have been involved in the removal of compressor.

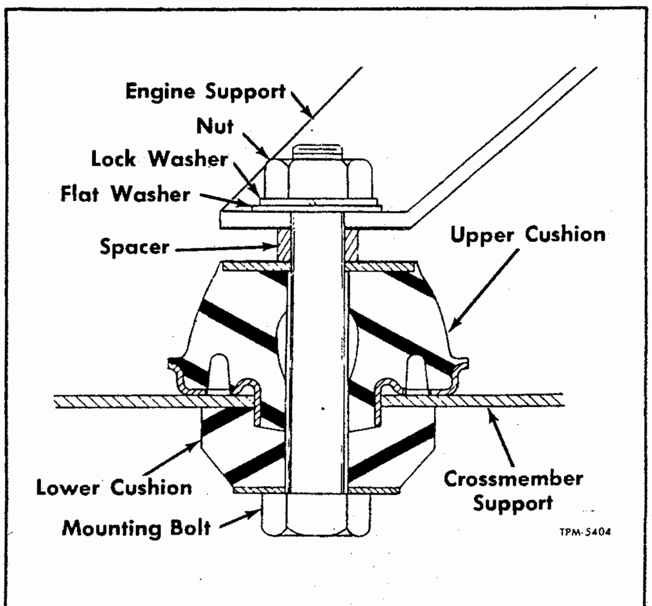


Figure 44—Engine Mounting

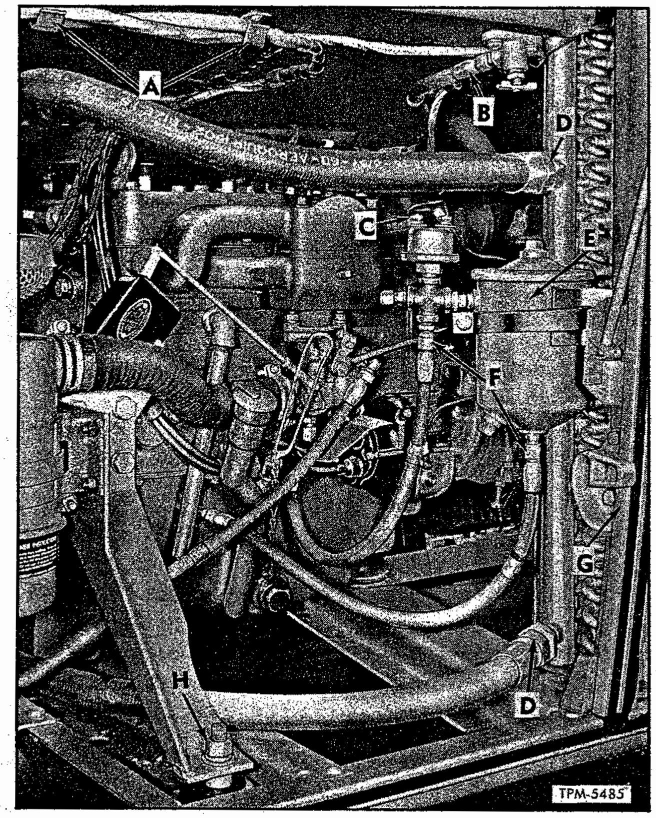


Figure 45—Disconnect Points Prior to Removing Condenser and Fan

ENGINE WITH COMPRESSOR REMOVAL

EQUIPMENT

A special fixture or dolly is required for removing and installing the air conditioning engine and compressor assembly. Since the air conditioning compartment side rail is not removable and the compartment ceiling prevents raising the unit straight up sufficiently to clear the side rail, the fixture must provide a means of raising or lowering the unit at the same time it is being moved outward or inward. A dolly for accomplishing this operation can be fabricated locally, and should incorporate the following features:

1. The complete unit should be mounted on caster type wheels to permit maneuverability.
2. The support arms must be constructed in such a manner that one will fit under the engine at front mounting, and the other will fit under the compressor. Provisions should be made to prevent the unit from tipping on the support arms.
3. Provisions for raising and lowering the unit must be incorporated in the unit and should be controlled by a screw jack.

REMOVAL PROCEDURE

1. Remove air conditioning engine compartment door and screened condenser compartment door as directed under "Exterior Compartment Doors" in BODY (SEC. 3).
2. Remove stone shields from under air conditioning unit compartment. Shields are held in place by spring-loaded eye-bolts.
3. Pump down the system as directed later under "Pumping Down The System." Make sure all compressor and liquid receiver valves are closed.
4. Disconnect wires (C - fig. 45) from low oil pressure switch and magneto. Disconnect flexible oil lines (F - fig. 45) from oil filter and from tee fitting at bottom of low oil pressure switch. Remove clamp bolt securing oil filter (E - fig. 44) in bracket, remove oil filter, then remove oil filter bracket from removable post.
5. Disconnect flexible refrigerant lines (D - fig. 45) from condenser. Seal ends of lines and openings in condenser flanges with tape.
6. Loosen wing nuts on condenser swing bolts and disengage bolts from brackets on condenser. Grasp condenser handle and swing condenser outward. Support condenser securely to prevent damage during removal.
7. From under vehicle, remove nut, lock washer, and plain washer securing condenser stop link bolt (C - fig. 42) in bracket on compartment side rail. Lift bolt out of bracket and fan shroud, then fold stop link against condenser.
8. Remove bolts attaching condenser hinge to bracket on removable post. Carefully remove condenser assembly (D - fig. 42).
9. Remove two bolts securing removable post (G - fig. 45) at upper end. Remove two countersunk head bolts attaching post brace to cross-member, and remove two bolts attaching post lower bracket to side rail. Remove post, lower brace, and condenser hinge bracket assembly.
10. From under vehicle, loosen condenser fan drive belt idler pulley adjusting bolt. Lower idler pulley, then remove fan drive belt.
11. Remove bolts (A - fig. 42) attaching fan shroud to compartment side rail and to compartment ceiling, then remove fan and shroud assembly (B - fig. 42).
12. Drain cooling system as directed under "Maintenance" in "HEATING AND VENTILATION" (SEC. 3). Loosen hose clamps attaching radiator upper hose to radiator and to cylinder head water outlet. Remove hose. Loosen hose clamps attaching hose to water pump and to radiator outlet fitting. Remove water pipe and hoses.
13. Disconnect cooling system vent lines from fitting at top of air conditioning engine compartment from bulkhead or from tee fitting on engine water pump outlet.
14. Remove bolts attaching exhaust pipe flange to engine exhaust manifold. Disconnect exhaust pipe from muffler at inner side of radiator and remove exhaust pipe. Seal openings in manifold

and radiator fittings with tape.

15. Close fuel line shut-off valve at forward side of compartment front bulkhead (fig. 32). Disconnect flexible fuel line from fitting at front bulkhead. Seal ends of line with tape.

16. Disconnect hi-lo pressure switch lines from compressor discharge and suction valves. Seal ends of lines and connections at compressor valves with tape.

17. Mark lines, then disconnect flexible refrigerant line from liquid receiver inlet valve and remove flexible line. Close opening in line and valve with tape.

18. Disengage engine wiring harness (A - fig. 45) from clips on compartment ceiling, and disconnect wires from junction block on bulkhead. Disconnect starter cable and switch wire from starter magnetic switch. Tape end of cable to prevent short circuit.

19. Remove light bulb from top of liquid receiver by pulling bulb out of sight glass cover.

20. Remove nut, lock washer, and bolt from each of three engine mountings.

21. Position dolly to support engine and compressor assembly. Raise the unit just enough to lift engine mounting brackets off crossmembers. Check to make sure that all disconnections have been made.

22. Manipulate the dolly as necessary to carefully withdraw the unit from the compartment. As the unit is moved outward, it must at the same time be raised so the engine oil pan will clear the compartment side rail. NOTE: If dolly being used does not provide suitable maneuverability, removing oil pan and oil pump screen will be helpful.

23. Set engine and compressor assembly on a suitable platform, with hole in center for engine oil pan, so that the three engine mounting brackets are supporting all of the weight.

24. If vehicle is to be operated with air conditioning unit removed, make sure all openings in refrigerant lines and connections, radiator, and fuel line are tightly sealed with tape to prevent entrance of dirt and moisture. Drain gasoline from air conditioning engine fuel tank. Install removable door post (step 14 under "Engine and Compressor Installation"). Install engine and condenser compartment doors as directed under "Exterior Compartment Doors" in BODY (SEC. 3).

25. If unit is to remain out of vehicle for an extended period, refer to "Compressor Storage" previously in "SYSTEM MAINTENANCE" for storage precautions.

ENGINE AND COMPRESSOR INSTALLATION

If engine and compressor have been removed and stored during the winter months, inspection and service operations outlined later under "Preparing Unit for Operation" should be accomplished. Before installing engine and compressor assembly in vehicle, the liquid receiver and engine radiator should first be installed in compartment (if they were removed). Engine support brackets should also be installed on engine before it is installed in vehicle. Refer to "Equipment" under "Engine and Compressor Removal" for description of engine and compressor dolly.

1. If vehicle has been in operation with engine and compressor removed, remove engine and condenser compartment doors as directed under "Exterior Compartment Doors" in BODY (SEC. 3). Also remove air conditioning compartment removable door post as directed in step 9 under "Engine and Compressor Removal."

2. Place engine and compressor assembly on dolly.

3. Raise unit just enough to permit engine oil pan to clear the compartment side rail. See NOTE in step 22 under "Engine and Compressor Removal." Move unit into position, lowering unit as it is moved into place. Align holes in engine mounting brackets with holes in crossmembers, position upper half of engine mount with spacer between engine support and frame, then remove dolly.

4. Secure each of three engine mountings with a bolt, plain washer, lock washer, and nut and lower half of engine mount (fig. 44).

5. Connect starter cable and switch cable to starter magnetic switch. Connect engine ground straps. Connect harness wires to junction block on bulkhead, referring to Wiring Diagram in back of manual for wire identification. Secure harness to compartment ceiling with clips.

6. Connect flexible refrigerant line to liquid receiver inlet valve. Refer to "Refrigerant Line Connections" in "SYSTEM MAINTENANCE" section.

7. Connect hi-lo pressure switch lines to tee fittings at compressor suction and discharge valves.

8. Connect flexible fuel line to fitting at bulkhead. Open fuel line shut-off valve (fig. 32).

9. Connect exhaust pipe flange to engine exhaust manifold. Connect exhaust pipe to muffler at inner side of radiator.

10. Install water pipe and connect to water pump and radiator outlet fitting with hoses. Install radiator upper hose between radiator inlet and cylinder head outlet fitting. Tighten all hose clamps firmly.

11. Connect vent line from engine head water outlet to tee at top of air conditioning engine compartment front bulkhead.

12. Install fan and shroud assembly (B - fig. 41) in compartment and attach to compartment ceiling and side rail with bolts (A - fig. 42).

13. Install fan drive belt in fan, drive, and idler pulleys. Adjust belt tension as directed pre-

viously under "Condenser and Radiator Fan and Drive" in "POWER PLANT MAINTENANCE."

14. Install removable post (G - fig. 45), lower brace, and condenser hinge bracket assembly. Attach lower brace to crossmember with two countersunk head bolts, and attach post lower bracket to side rail with two bolts. Attach upper end of post with two bolts.

15. Position condenser assembly at side of vehicle in open position with condenser hinge in place at hinge bracket on post. Block condenser securely in place to prevent damage. Attach condenser hinge to hinge bracket with bolts, lock washers, and nuts.

16. Connect condenser stop link to bracket on side rail with bolt (C - fig. 42), plain washer, and nut. Swing condenser into place and secure with condenser swing bolts.

17. Connect flexible refrigerant lines (D - fig. 45) to condenser. Refer to "Refrigerant Line Connections" in "SYSTEM MAINTENANCE" section.

18. Install oil filter bracket on removable post, then install oil filter (E - fig. 45). Connect flexible oil lines (F - fig. 45); line leading to engine oil pan connects to outlet fitting at bottom of oil filter, and line leading from engine crankcase connects to bottom of tee fitting below low oil pressure switch. Connect wires (C - fig. 45) to low oil pressure switch terminals.

19. Install engine and condenser compartment doors as directed under "External Compartment Doors" in BODY (SEC. 3).

20. Make sure drain cocks in bottom of radiator and at left side of engine cylinder block (fig. 39) are closed, then fill cooling system as directed under "Maintenance" in "HEATING AND VENTILATION" (SEC. 3). Fill fuel tank as previously directed in "OPERATING INSTRUCTIONS."

21. Accomplish services outlined under "Refrigerant Valves," "Preparing Unit for Operation," "Purging the System," "Testing for Leaks," and "Checking for Air in System" following.

PREPARING UNIT FOR OPERATION

When air conditioning engine and compressor have been inoperative during the winter months, certain inspection and service operations must be accomplished before the unit is placed back in operation.

1. If compressor has been overhauled, make sure proper amount of oil (4, pints) has been replaced in compressor.

2. Charge compressor with refrigerant to provide internal pressure. Remove closure plate (7, fig. 5) from top of compressor.

3. Turn engine over several revolutions with starter, but do not start engine. Through the closure plate opening, check for evidence of oil or refrigerant leakage past the compressor crankshaft seal.

4. If shaft seal leaks, remove compressor from engine and replace the shaft seal assembly.

5. When compressor is removed from engine, examine bushings in engine flywheel. If wear or deterioration is evident, replace with new bushings.

6. In any event, before running engine, engine should be turned over several revolutions with starter to circulate oil through the compressor.

REFRIGERANT VALVES

Before starting air conditioning engine after storage or inactive period and during operation of system, refrigerant valves must be in "Operating Position." When system has been pumped down and is being prepared for operation, open valves in the following sequence:

1. Receiver Liquid Out Valve - Fully Open.
2. Compressor Suction Valve - Refer to "System Maintenance."
3. Compressor Discharge Valve - Refer to "System Maintenance."
4. Receiver Inlet Valve - Fully Open.

PURGING THE SYSTEM

Whenever system has been pumped down or evacuated and system has been opened, or if operating difficulties indicate air in the system, purge air from system as follows:

1. Place refrigerant valves in "Operating Position" to admit refrigerant gas to entire system.

2. To purge air from liquid receiver loosen fusible safety plug in top of receiver. Tighten plug after a small amount of refrigerant gas has escaped.

3. To purge evaporator, loosen external equalizer tube fitting at expansion valve, permit a small amount of gas to escape, then tighten fitting.

4. If a large amount of air is indicated, it may be necessary to pump the refrigerant into a refrigerant tank and purge the air from the tank. To accomplish this, remove cap from compressor discharge valve stem and backseat the valve. Remove cap from gauge port on discharge valve tee and connect line from refrigerant tank to tee. Turn discharge valve stem all the way in, then back out one or two turns to permit some circulation of refrigerant gas. While cooling refrigerant tank with water, run engine to pump the refrigerant into the tank. Continue to run engine until low pressure switch stops it. As soon as engine stops, backseat compressor discharge valve and close valve at refrigerant tank. Let tank stand for several hours, bleed air off top of tank, then transfer the refrigerant back into the system as directed later under "Charging the System."

TESTING FOR LEAKS

Whenever repairs or adjustments have been made to any part of the refrigerating system which necessitate disconnecting refrigerant lines, connections should be tested for leakage before the unit is restored to service. First admit only enough gas into the system to produce 5 or 10 pounds pressure, then test for leaks (fig. 46). If no leaks are found at this pressure, increase pressure 5 or 10 pounds, and test for leaks again. In this way, only a slight amount of refrigerant gas will be lost in the event there is a leak. Final test should be made with system under operating pressure. Large leaks will be indicated by oil seepage and must be repaired immediately.

REFRIGERANT LEAK DETECTOR

Refrigerant leak detector, commonly called a Halide Lamp, is a small torch which burns methyl alcohol. Air used in burner is drawn through a flexible sampling tube. Operation of leak detector is as follows:

Pressure is produced in the lamp fuel tank by heat of generation at time alcohol is burned in small cup under burner. Observe color of flame when clear air is being drawn through the sampling tube. Color of flame may vary depending on type and grade of alcohol used in burner.

By holding open end of sampling tube under connections, joints, valves, etc. (fig. 46), any traces of refrigerant would be drawn through the tube to the burner and would be immediately evident by the change in color of the flame. Refrigerant breaks down when coming in contact with the heated copper ring in burner and changes the color of the flame. Do not confuse change in color with change caused by shutting off air supply in holding end of sampling tube too close to some object.

Instructions are supplied with leak detector and should be carefully studied. Only high grade Anhydrous Methyl Alcohol as listed under "Equipment and Material" at end of this group should be used in burner.

Leak detectors which burn acetylene gas are also available and may be used.

When refrigerant has been lost, adding refrigerant without knowing cause or location of leak merely postpones corrective measures and increases maintenance costs. At two or three week intervals, go over entire system with leak detector. Check for leaks at all joints and connections throughout the system.

CHECKING FOR AIR IN SYSTEM

Air in refrigerating system causes excessive head pressures and reduction in cooling capacity. Check for air in system as follows:

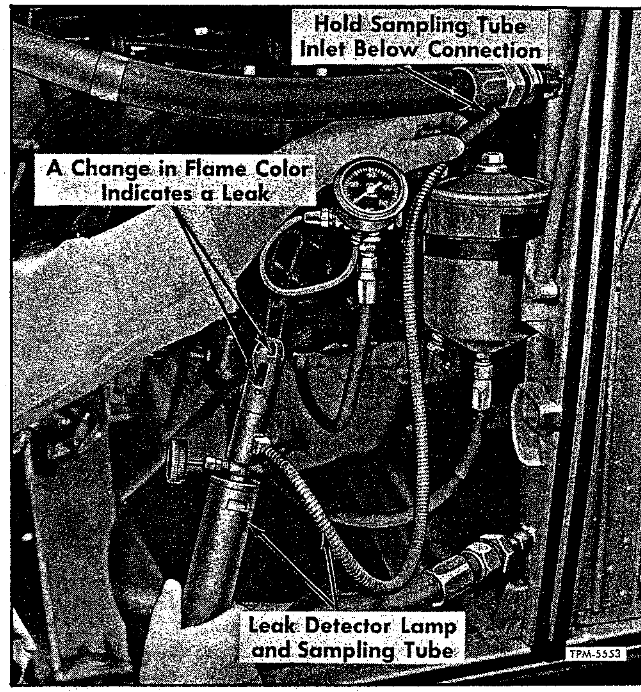


Figure 46—Testing For Refrigerant Leaks

1. Connect an accurate pressure gauge to tee at compressor discharge valve. Valve must be placed in operating position.
2. Hang an accurate thermometer in air conditioning unit compartment.
3. Allow unit to stand idle for several hours to allow temperatures of all parts to equalize, then note thermometer and gauge readings.
4. Compare readings with figures shown in pressure-temperature chart in "SYSTEM MAINTENANCE" in this group. If pressure gauge shows a reading of more than 3 pounds higher than pressure shown on chart for the existing temperature, air must be purged from system.

PUMPING DOWN THE SYSTEM

In order to accomplish any operations on the system which necessitate disconnecting refrigerant lines, it is necessary to first pump down the system to prevent appreciable loss of refrigerant. To pump down the system means to pump all of the refrigerant into the liquid receiver.

1. Remove cap from compressor suction valve and back valve stem out to backseated position. Remove cap from gauge port, connect a compound gauge to port, then turn valve stem in one turn.
2. Start engine and run for 10 or 15 minutes to permit the system to level out, then with engine still running, close the liquid out valve on top of liquid receiver by turning the valve stem in until the valve seats.
3. Continue to run engine until low pressure

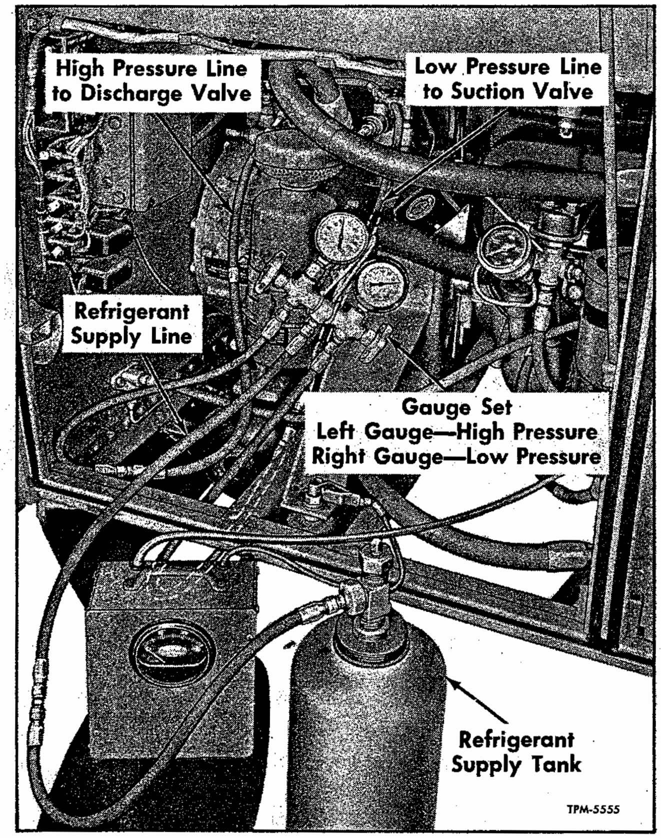


Figure 47—Method of Charging the System

switch stops it, observing pressure on gauge.

4. When suction pressure builds up to low pressure switch cut-in (22 pounds), again start engine and run until it again cuts out. Repeat on and off cycle several times, then close compressor suction valve by turning valve stem in until valve seats.

5. Close receiver inlet valve and compressor discharge valve. Most of the refrigerant is now contained in the liquid receiver. A small amount of refrigerant in a gaseous state remains in compressor, condenser, and lines. Gas will be retained in compressor unless valves are opened. The small amount remaining in condenser and refrigerant lines will be lost when lines are disconnected.

TO EVACUATE THE SYSTEM

Whenever the refrigerant system has been opened to a point where air and moisture has been admitted, it is necessary to thoroughly evacuate the system before recharging. Air in system causes high head pressure and reduces cooling capacity; moisture may cause damage to equipment. In case of emergency where a vacuum pump is not available, system may be blown out with refrigerant to eliminate air in system. This should only be done in case of emergency, since considerable refrigerant is used which is quite costly; also, a vacuum pump does a more satisfactory job. Any reliable refrigerant vacuum pump may be used. The following procedure will evacuate the entire system.

1. Connect vacuum pump to gauge port at compressor discharge valve.

2. Be sure all valves are in operating position.

3. Operate vacuum pump to give maximum vacuum for at least two hours.

4. Backseat the discharge valve with pump running, disconnect pump from gauge port, and install cap on tee.

NOTE: In case only a small portion of the system has been opened to atmosphere, that portion of the system may be blown out with refrigerant gas or evacuated as desired.

CHARGING THE SYSTEM

ADDING REFRIGERANT

Before adding any refrigerant to system, make sure all leaks have been repaired, then proceed as follows:

1. Remove cap from compressor suction valve stem and turn valve stem out to backseated position. Remove cap from gauge port on suction valve tee and connect line from refrigerant tank through gauge to gauge port (fig. 47), leaving the connection loose. Crack tank outlet valve to permit refrigerant gas to expel all air from gauge line, then tighten connection.

2. Place suction valve in operating position (turned 1/2 to 1 turn away from backseated position). Open outlet valve on refrigerant tank.

3. With refrigerant tank in an upright position, heat tank with warm water to force enough gas into system to build up pressure to the low pressure switch cut-in point (22 psi). (CAUTION: Use only warm water to heat tank; do not use a torch or flame of any kind.) This can be determined by intermittently pressing the "START" button on control panel. As soon as starter will operate, discontinue heating refrigerant tank and start the engine. Compressor will then draw refrigerant into the system. Run engine at governed speed until refrigerant level in receiver sight glass (fig. 8) is at middle of glass.

4. Backseat compressor suction valve, close refrigerant tank outlet valve, and disconnect tank line from gauge port. Install cap on gauge port at tee, place suction valve in operating position, and install valve cap.

CHARGING AN EMPTY SYSTEM

A system which has been evacuated can be charged in same manner described above for "Adding Refrigerant." However, if engine cannot be operated, refrigerant can be transfered from refrigerant tank to system by applying warm water to

refrigerant tank and cooling the liquid receiver with cold water. When charging system in this manner, refrigerant must be weighed, as the unit must be running to determine proper refrigerant level in liquid receiver sight glass. A full charge of refrigerant is 25 pounds. If possible, tank should be placed on scales while transferring refrigerant so the proper quantity can be determined.

PREPARATION OF SYSTEM FOR WINTER OPERATION

Vehicle can be operated with the air conditioning engine and compressor removed for reduced weight, or it can be operated without removing the engine and compressor. If the engine and compressor are to remain in the vehicle during the inactive period, the system should be pumped down and all refrigerant valves closed, the air conditioning engine cooling system should be drained and isolated from heating system, and the air conditioning engine fuel tank should be drained. The engine should also be turned over several revolutions with starter every four or five days to keep oil on the compressor shaft seal and on compressor and engine bearings. If unit is to be stored out of the vehicle, refer to "Compressor Storage" previously in "SYSTEM MAINTENANCE."

Trouble Shooting

Most any trouble in the air conditioning system will produce the same symptom -- Insufficient Cooling. The following chart deals with locating and correcting the various causes of insufficient cooling. Minor trouble symptoms and their corrections are covered under "Driver's Trouble Shooting" in "OPERATING INSTRUCTIONS" section of this group.

IMPORTANT

ONE OF THE MOST COMMON CAUSES OF INSUFFICIENT COOLING IS A DIRTY, CLOGGED CONDENSER. THIS CONDITION SHOULD BE CHECKED FREQUENTLY AND CORRECTED AS EXPLAINED ON PAGE 312.

1. Underfloor Blower Not Running
   - (a) Loose or Broken Blower Drive Belt . . . . Tighten or replace
   - (b) Loose Electrical Connections . . . . Tighten
   - (c) Defective Circuit Breaker . . . . Replace
   - (d) Defective Magnetic Switch . . . . Replace
   - (e) Defective Blower Motor . . . . Replace

2. Dehydrator - Strainer Clogged . . . . Page 313

3. Underfloor Air Filter Clogged . . . . Page 317

4. Compressor
   - (a) Too Much Oil . . . . Page 311
   - (b) Compressor Valves Not in Operating Position . . . . Page 311
   - (c) Compressor Worn (indicated by high suction pressure) . . . . Replace

5. Improper Engine Speed
   - (a) Throttle Control Requires Adjustment . . . . Page 337

6. Low Refrigerant
   - (a) Leaks in System . . . . Page 347
   - (b) Recharge System . . . . Page 348

7. Expansion Valve
   - (a) Capillary Tube Broken . . . . Page 314
   - (b) Equalizer Tube Restricted . . . . Page 314
   - (c) Gummed Cage . . . . Page 316
   - (d) Check for Proper Superheat . . . . Page 315

8. Engine Cuts Out or Fails to Start at High Outside Temperature
   - (a) Dirty Condenser . . . . Page 312
   - (b) Loose or Broken Condenser Fan Belts . . . . Page 342
   - (c) Too Much Refrigerant . . . . Page 313
   - (d) Air in System . . . . Page 347
   - (e) Restricted Fuel Line . . . . Clean or Replace
   - (f) Defective Fuel Pump . . . . Page 332
   - (g) Defective Fuel Pump Relay . . . . Page 334
   - (h) Defective Carburetor . . . . Page 335
   - (i) Overheated Engine . . . . Page 338
   - (j) Defective Ignition System -- Tune-up Engine . . . . Page 325

9. Engine Loses RPM at High Outside Temperature
   Items a, b, c, d, and h above will cause engine to slow down.

Lubrication and Inspection

The following tabulation lists lubrication and service points, service required, and the recommended intervals at which these services should be accomplished. These services should be accomplished at more frequent intervals when system is operated under severe conditions such as extremely high temperatures. References in right-hand column refer to group page numbers where service procedures are covered, or to Lubrication Notes on page 352 for recommended lubricant and proper application.

Item	Service Required	Daily	At Inspection	50 Hrs.	See Footnote	Refer to
Engine Crankcase	Check Oil Level - Add if Required	X				Page 308
	Drain and Refill			X		Note 1 (next page)
Engine Air Cleaner	Clean and Refill			X		Note 2 (next page)
Engine Radiator	Clean Air Passages		X			--
Engine Mounting Bolts	Tighten		X			--
Compressor	Check Oil Level - Add if Required	X				Page 312
	Drain and Refill				(3)	--
	Tighten Mounting Bolts		X			--
Compressor Suction Valve	Tighten Mounting Bolts and Valve Caps		X			--
Compressor Discharge Valve	Tighten Mounting Bolts and Valve Caps		X			--
Liquid Receiver	Check Refrigerant Level	X				Page 313
	Tighten Mounting Bolts		X			--
Magneto	Clean Points and Adjust			X		Page 328
Magneto Cut-Out Relay	Clean and Adjust Points		X			Page 329
Oil Filter	Replace Cartridge			X		Page 340
Fuel Pump	Clean Cover	X				Page 333
Carburetor	Clean and Adjust				(1)	Page 337
Spark Plugs	Clean and Regap			X		Page 330
Condenser	Clean Air Passages as Necessary	X	X			Page 312
Condenser Fan Belts	Check Belt Tension - Adjust if Necessary		X			Page 342
Condenser Fan and Bearings	Lubricate With Hand Gun					Note 4 (next page)
Dehydrator Strainer	Replace Cartridge				(2)	Page 313
Air Filter	Clean and Re-oil		X			Note 3 (next page)
Evaporator	Clean		X			Page 316
Fuel Pump Relay	Clean and Adjust Points		X			Page 334
Hi-Lo Pressure Switch	Check Adjustment		X			Page 317
Compartment Control Panel	Tighten Connections		X			--
Driver's Control Panel	Tighten Connections		X			--

(1) At 500 hours
(2) Whenever system has been opened
(3) After initial 200 hrs. of operation

LUBRICATION AND INSPECTION (CONT'D)

LUBRICATION NOTES

NOTE 1—ENGINE OIL

Use only HEAVY DUTY OILS meeting Specification MIL-O-2104, designated as Type A in list published in I.C.E.I. (Internal Combustion Engine Institute). Oil having an S.A.E. 30 viscosity should be used. Crankcase capacity is 3-1/2 quarts, plus 1/2 quart for oil filter.

NOTE 2— COMPRESSOR OIL

A special wax-free dehydrated refrigerant type oil having a viscosity about the equivalent of S.A.E. 10 must be used. This oil is readily available through major oil companies. Approved oils are: Texaco Capella D; Ansul 300 non-foaming; Std. Oil of Calif., Caloil 13W. Oil should be obtained in sealed cans. Never use bulk oil or oil which has been exposed to air for any length of time. Drain and refill after first 200 hours of operation. The compressor capacity is 4 pints.

Oil Filter. Oil filter should be drained and the element changed at engine oil change periods. clean body of filter thoroughly when replacing element.

Air Cleaner. Clean and refill at engine oil change periods or more often if conditions warrant, using oil having an S.A.E. 20 viscosity. Air reservoir capacity is one-half pint.

NOTE 3—ODORLESS OIL

Air Filter. Thoroughly clean filter, then spray, or dip and let drain, with light odorless oil, such as medicinal white oil.

NOTE 4—MULTI-PURPOSE GREASE

Condenser Fan Bearings. At regular chassis lubrication intervals during the operation of system only lubricate two condenser fan bearings using hand pressure gun. Apply only one stroke of gun. Excessive pressure may damage bearing seal.

Equipment and Materials

The following equipment and materials are required for servicing the GM Coach Air Conditioning System. This equipment and material can be procured locally or from any reliable air conditioning or refrigeration supply house.

EQUIPMENT

Thermometer with Remote Reading Dial - For use in conjunction with expansion valve adjustment.

Tachometer - For engine speed adjustment. A special electric tachometer is required for use with a magneto ignition system.

Soldering Torch and Cylinder of Gas - For soldering refrigerant line fittings.

Oil Pressure Gauge - For checking engine oil pressure.

Leak Detector - For checking for refrigerant leaks.

Vacuum Pump and Gauge - For evacuating the system. Should be capable of pulling 28 inches of mercury vacuum.

Hand Oil Pump - For adding oil to a charged system.

Pressure and Vacuum Gauge Set - For checking refrigeration system operation.

MATERIALS

Anhydrous Methyl Alcohol - For use in leak detector.

Freon-12 or Genetron-12 Refrigerant - Do not use any other types of refrigerant in this system.

Solder - 95% tin and 5% antimony - For soldering refrigerant line fittings.

Nokorode Soldering Paste - For use on soldered fittings.

Refrigerant Control Specifications

COMPRESSOR

Make	Trane
Model	C-563
Rated Capacity at 2000 RPM	
Maximum Head Pressure	250 psi (gauge)
Suction Pressure	10-45 psi (gauge)
Initial Oil Charge	4 pts.

DEHYDRATOR - STRAINER

Make	Ansul Chemical Co.
Dehydrant	Activated Alumina

EXPANSION VALVE

Make	Alco Valve Co.
Type	DT2262-2-18FG-55
Adjustment	External
Setting	9°-10° Superheat

HI-LO PRESSURE CUT-OUT SWITCH

Make	Penn Electric Switch Co.
Type	277BP12
Model	1500
High Pressure Switch	
Opens at	250 psi (gauge)
Closes at	200 psi (gauge)
Low Pressure Switch	
Opens at	7 psi (gauge)
Closes at	22 psi (gauge)

Basic Engine Specifications

ENGINE GENERAL DATA

Make	Continental
Model	Y91
Type	L-Head
Number of Cylinders	4
Compressed Ratio	6.6 to 1
Firing Order	1-3-4-2
Piston Displacement (cu. in.)	90.9
Cylinder Bore	2-7/8"
Piston Stroke	3-1/2"
Horsepower (S. A. E.)	
Governed Speed (no load)	2000 rpm

	Sizes and Fits of New Parts	Wear Limits
CYLINDER BLOCK		
Bore Size (std.)	2.875"-2.877"	*2.885"
Main Bearing Bore Dimension	1.8740"-1.8747"	
CRANKSHAFT		
Number of Bearings	3	
End Clearance	0.005"-0.008"	
Connecting Rod Journal Diameter (Std.)	1.499"-1.500"	
Out-of-Round (Max.)	0.0005"	
Main Bearing Journals Diameter (Std.)	1.7475"-1.7485"	*1.7465"
Main Bearing Clearance	0.0002"-0.0024" (vertical)	*0.0034"
Main Bearings Available in following Undersizes:	0.002", 0.020", 0.022" and 0.040"	
FLYWHEEL		
Runout	0.006" (Max.)	
CONNECTING ROD		
Upper Bore Diameter	0.7622"-0.7632"	
Lower Bore Diameter	1.609"-1.610"	
Connecting Rod Bearing - Upper		
Type	Bronze Bushing	
Finish Bore	0.7087"-0.7089"	*0.7099"
Bushing to Pin Clearance	0.0002"-0.0006"	0.0015"
Connecting Rod Bearing - Lower		
Type	Replaceable Insert	
Clearance	0.0002"-0.0022" (vertical)	*0.0034"
Undersize Available	0.002", 0.020", 0.022" and 0.040"	
PISTON		
Piston Diameters (Std.)		
At Top of Skirt	2.8695"-2.8700"	
At Bottom of Skirt	2.8715"-2.8720"	

NOTE: Pistons are available in following oversizes: 0.020", 0.030" and 0.040".

Piston to Cylinder Wall Clearance (Taken on Thrust Side)	
At Top of Skirt	0.0055"-0.007"
At Bottom of Skirt	0.0035"-0.006"

* NOTE: Wear limits are effective only when total clearance does not exceed maximum allowed as shown under clearance limits.

AIR CONDITIONING

PISTON (Cont'd.)	Sizes and Fits of New Parts	Wear Limits
Ring Groove Width		
Compression	0.0955"-0.0960"	*0.0975"
Oil	0.1565"-0.1575"	
Piston Pin Hole Diameter (Reamed)	0.7084"-0.7086"	*0.7085"
Piston Pin Diameter	0.7083"-0.7085"	*0.7081"
Piston Pin Clearances		
In Connecting Rod	0.0002"-0.0006"	0.0015"
In Piston	Light Push Fit (both parts at 160°F.)	

PISTON RINGS (Std.)

	No. Req'd.	
Compression Rings	2	2.875" x 0.09325"
Oil Rings	1	2.875" x 0.15475"

Top compression ring is chrome plated, with butt joint and tapered face. 2nd compression ring is butt joint type with steel expander and tapered face. Oil ring is heavy duty butt joint type.

Ring to Groove Clearance		
Compressor Rings	0.0023"-0.0035"	*0.0045"
Oil Ring	0.0018"-0.0028"	*0.0045"
Piston Ring Gap	0.007"-0.017"	

NOTE: Service piston rings are available in following oversizes: 0.020", 0.030", and 0.040" as well as standard size.

CAMSHAFT		
Number of Bearings	3	
Thrust Plate Thickness	0.147"-0.149"	
Thrust Plate to Shaft Clearance	0.003"-0.006"	
Bearing Clearance		
Front	0.002"-0.004"	*0.0055"
Intermediate	0.003"-0.0065"	*0.0055"
Rear	0.003"-0.006"	*0.0055"
Bearing Journal Diameter		
Front	1.8085"-1.8095"	1.8075"
Intermediate	1.7457"-1.7465"	1.7447"
Rear	1.2465"-1.2475"	1.2455"
Bearing Diameter - Ream		
Front	1.8115"-1.8125"	1.8135"
Intermediate	1.7495"-1.7502"	1.7512"
Rear	1.2495"-1.2505"	1.2515"

OIL PUMP	
Gear Backlash	0.001"-0.005"
Gear Width	0.7485"-0.7500"
Drive Gear Bore	0.4982"-0.4992"
Idler Gear Bore	0.5035"-0.5045"
Housing Drive Shaft Bore	0.500"-0.501"
Diameter	
Drive Shaft	0.4985"-0.4990"
Idler Shaft	0.5015"-0.502"

OIL PRESSURE RELIEF SPRING	
Free Length	2"
Lbs. Pressure @ 1-3/8"	13-1/8

* NOTE: Wear limits are effective only when total clearance does not exceed maximum allowed as shown under clearance limits.

	Sizes and Fits of New Parts	Wear Limits
INTAKE VALVE		
Lash	0.012"	
Seat Angle	30 Degrees	
Length - Overall	3-63/64"	
Stem Diameter	0.3141"-0.3149"	0.3121"
Guide Ream	0.3157"-0.3167"	0.3182"
Stem to Guide Clearance	0.0008"-0.0026"	0.0036"
EXHAUST VALVE		
Lash	0.012"	
Seat Angle	44 Degrees	
Length Overall	4"	
Stem Diameter	0.3124"-0.3132"	0.3104"
Guide Ream	0.3157"-0.3167"	0.3182"
Stem to Guide Clearance	0.0025"-0.0043"	0.0063"
VALVE TAPPET		
Diameter	0.9990"-0.9995"	0.998"
VALVE SPRING		
Free Length	2-1/16"	
Lbs. Pressure @ 1-45/64"	47-53	
Lbs. Pressure @ 1-27/64"	96-104	

Miscellaneous Specifications

ENGINE SPARK PLUGS

Make	AC
Type	86 Com.
Gap	.030"

AIR INTAKE SYSTEM

Air Cleaner	
Make	Vortex
Type	Oil Bath
Oil Capacity	3/4 pint

FUEL SYSTEM

Tank Capacity	24-1/2 gal.
Fuel Pump	
Make	Bendix
Model	477223
Operating Current @ 12 Volts	0.65 Amps (Max.)
Pressure	3 psi + or - 1/4 lb.
Fuel Pump Relay	
Make	Delco-Remy
Model	1116797
Air Gap - Points Closed	0.012"
Point Opening	0.020"
Closing Voltage	
Range	7.0-9.0
Adjust to	8.0
Carburetor	
Make	Zenith
Model	161X7
Stamped	11772
Venturi	16
Main Jet	20
Idling Jet	14
Main Discharge Jet	60
Well Vent	27
Fuel Valve Seat	35
Float Level	1-15/32" + or - 3/64"
Electric Choke	
Make	Pierce
Model (Stamped on Lever)	AC-1112

MAGNETO

Make	Fairbanks-Morse
Type	FMXZ4B16C
Mounting	Flange
Drive	Impulse Coupling
Rotation	Clockwise
Breaker Point Gap	0.015"

MAGNETO CUT-OUT RELAY

Make	Delco-Remy
Model	1116845
Air Gap -Armature Down	0.012"
Point Opening - Armature Down	0.020"
Closing Voltage	6.0 Min.
Opening Voltage	
Range	9.0-10.6
Adjust to	9.5

COOLING SYSTEM

Thermostat	
Closed at	157°F.
Starts to open at	157°F.-162°F.
Fully open at	182°F.

OIL FILTER

Make	AC
Model	L-5
Capacity	1/2 qt.
Replacement Cartridge	P-111

STARTING SYSTEM

Starting Motor	
Make	Delco-Remy
Model	1107630
Rotation (Viewed from Drive End)	Clockwise
Brush Spring Tension	30-40 oz.

STARTING SYSTEM	
No Load Test	
Maximum Amps.	95
Volts	10.1
Approx. rpm	3500
Load Test	
Maximum Amps.	460
Volts	5.2
Torque (Minimum)	11 ft.-lbs.

Starter Magnetic Switch	
Make	Delco-Remy
Type	12-volt
Model	1496

LOW OIL PRESSURE SWITCH	
Make	AC
Stamped	1508157
Model	F-1
Break Pressure	10 psi + or - 1 psi

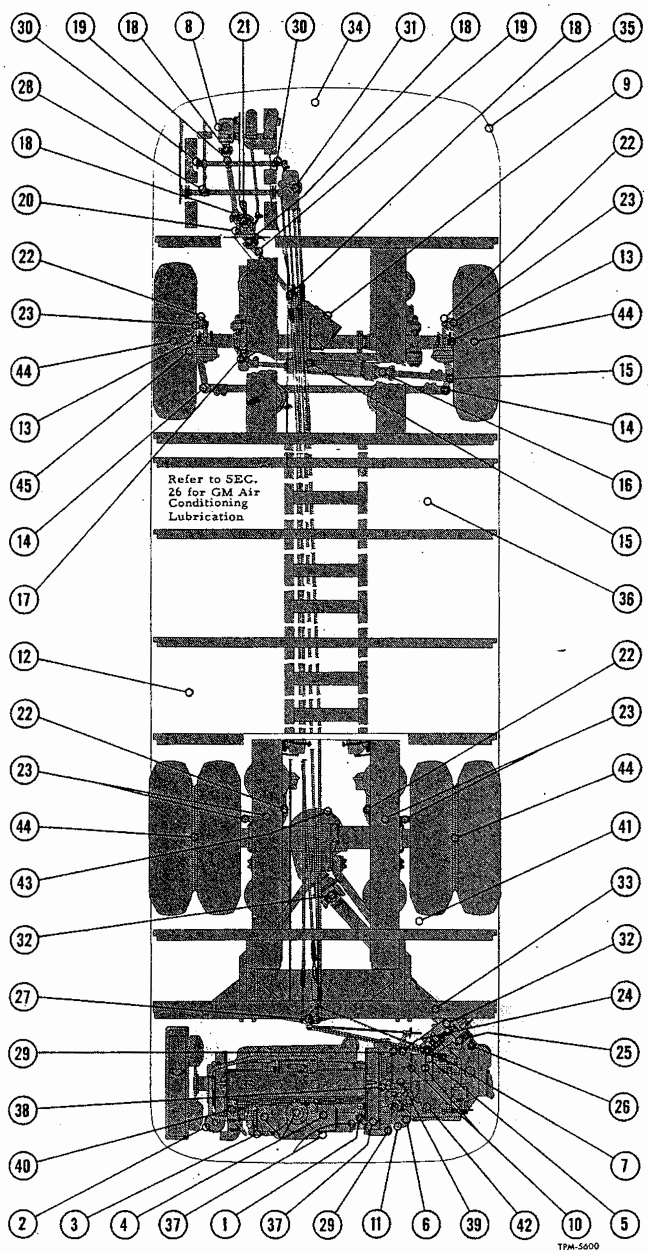
Special Tools

References are made to special tools in the various groups of this manual. These tools, or their equivalent, are necessary and are recommended to readily and efficiently accomplish certain service operations. The tools, however, are not supplied by GMC Truck & Coach Division. Names and addresses of Tool Vendors are given at the end of this tool list. Since these vendors are the suppliers of these tools, information regarding availability, prices, etc., should be obtained directly from them.

Tool No.	Tool Name	Vendor Code
	SECTION 3 - BODY	
J-2189	Seal and Insert Installer	KM
80-0202	Booster Water Pump Impeller Tool	B
	SECTION 5 - CLUTCH	
80-0061	Pilot Bearing Remover	B
80-0062	Aligning Arbor	B
	SECTION 6 - COOLING	
80-0041	Fan Hub Puller	B
	SECTION 7 - ELECTRICAL	
1568147	Electric Speedometer Test Light	AC
	SECTION 8 - ENGINE	
VO-233	Spanner Wrench	S
	SECTION 14 - AIR SUSPENSION	
J-6049-01	Height Control Valve Tool Set (Consists of the following tools)	KM
J-6049-2	Control Valve Wrench	
J-6049-3	Actuating Arm Shaft Remover and Replacer	
J-6049-4	Holding Fixture	
J-6049-7	Control Valve Lock Nut Wrench	
J-6049-8	Diaphragm Lock Nut Wrench	
	SECTION 17 - TRANSMISSION	
80-0223	Mainshaft Rear Bearing Nut Wrench	B
80-0161	Mainshaft Bevel Pinion Puller	B

VENDORS NAMES AND ADDRESSES

Vendor Code	Vendor Name	Address
KM	Kent-Moore Organization	Jackson, Michigan
B	Bacharach Industrial Instrument Co.	Pittsburgh, Penn.
AC	AC Spark Plug Division	Flint, Michigan
S	Skinner Chuck Co.	Norwalk, Conn.



Lubrication Chart

PD-4104

Item No.			Miles	Symbol
1	Engine	Keep to "FULL" Mark - 25 Qts.	Daily	E
2	Oil Strainer (Early Models)	Clean at Engine Drain	-	E
3	Oil Filter	Replace Element at Engine Drain	-	E
4	Blower Air Cleaners	Keep to Level Mark	1,500	E
5	Generator Air Cleaner	Wash and Dip in Light Oil	1,500	E
6	Power Steering System	To Level Mark on Pump	1,500	S19
7	Control Rod Linkage	Brush or Spray	1,500	E
8	Steering Column Bevel Gear Housing	Fitting - To Level of Breather	1,500	SG
9	Steering Gear Housing (At Axle)	Fitting - To Level of Breather	1,500	SG
10	Generator	One Turn of Each Cup	1,500	S2
11	Clutch Release Bearing	One Turn of Grease Cup	1,500	S2
12	Battery Terminals	Keep Coated	1,500	S3
13	Steering Knuckles	Two Fittings Each Side	1,500	C
14	Steering Tie Rod Ends	One Fitting Each End	1,500	C
15	Steering Drag Link Ends	One Fitting Each End	1,500	C
16	Steering Drag Link Ends (Power Stg.)	One Fitting - Hand Gun - Sparingly	1,500	SG
17	Steering Booster Ends (Power Stg.)	One Fitting Each End	1,500	C
18	Steering Prop. Shaft "U" Joints	One Fitting Each Joint	1,500	C
19	Steering Prop. Shaft Slip Joint	One Fitting Each Joint	1,500	C
20	Steering Prop. Shaft Support Bearing	One Fitting	1,500	C
21	Brake Application Valve	One Fitting	1,500	C
22	Slack Adjusters F. & R.	One Fitting Each	1,500	C
23	Brake Camshafts - F. & R.	One Fitting Each	1,500	C
24	Hand Brake Bell Crank Idler	One Fitting	1,500	C
25	Hand Brake Shoe Anchor Pin	Three Fittings	1,500	C
26	Speedometer Adapter	One Fitting	1,500	C
27	Control Rods Bell Crank Pin	One Fitting at Bulkhead	1,500	C
28	Clutch Pedal	One Fitting	1,500	C
29	Clutch Release Shaft Ends	One Fitting Each End	1,500	C
30	Clutch Control Cross Shaft	One Fitting Each End	1,500	C
31	Transmission Control Tower	One Fitting	1,500	C
32	Prop. Shaft "U" Joints	One Fitting Each Joint	1,500	C
33	Prop. Shaft Slip Joint	One Fitting	1,500	C
34	Destination Sign Cranks	Apply	1,500	C
35	Front Door Hinges	One Fitting Each Hinge	1,500	C
36	Under Floor Blower	Two Fittings - One Stroke of Hand Gun	3,000	MPG
37	Starter	Three Oil Cups	3,000	E
38	Clutch Pilot Bearing	Sparingly - Thru Temporary Fitting	3,000	S2
39	Shutter Air Filter	Inject 1 Oz. Fluid at Plug	3,000	S13
40	Governor Throttle Shaft	Thru Temporary Fitting (Sparingly)	5,000	C
41	Wash Basin Supply Motor	Two Oilers	15,000	E
42	Transmission	To Mark on Dipstick - 10-1/2 Qts.	15,000	ES
43	Rear Axle Differential	To Level of Filler Plug - 18 Pts.	15,000	MP
44	Wheel Bearing - F. & R.	Hand Pack or Use Lubricator Do Not Use Pressure Gun	15,000	S2
45	Tachograph Drive	Thru Temporary Fitting - Hand Gun	25,000	SG
	Shock Absorbers	Non-Refillable Type	-	-

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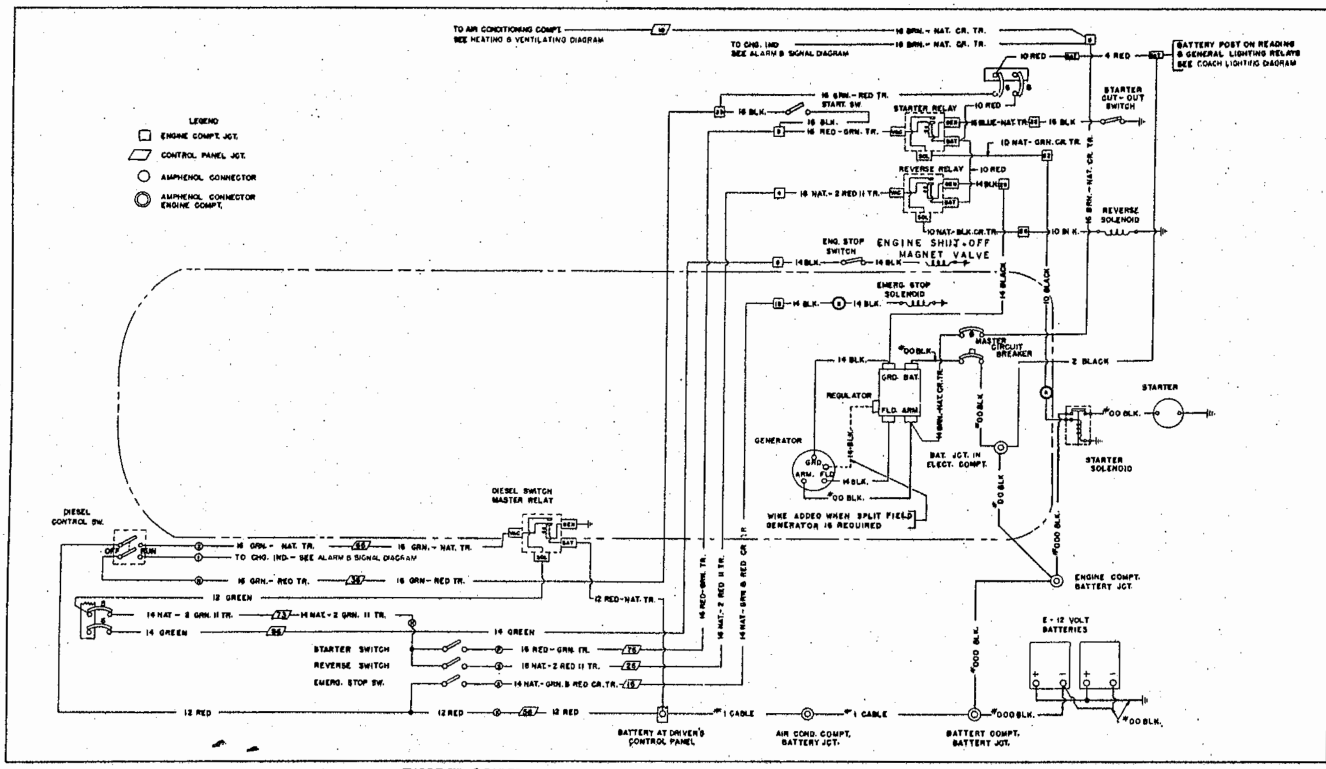
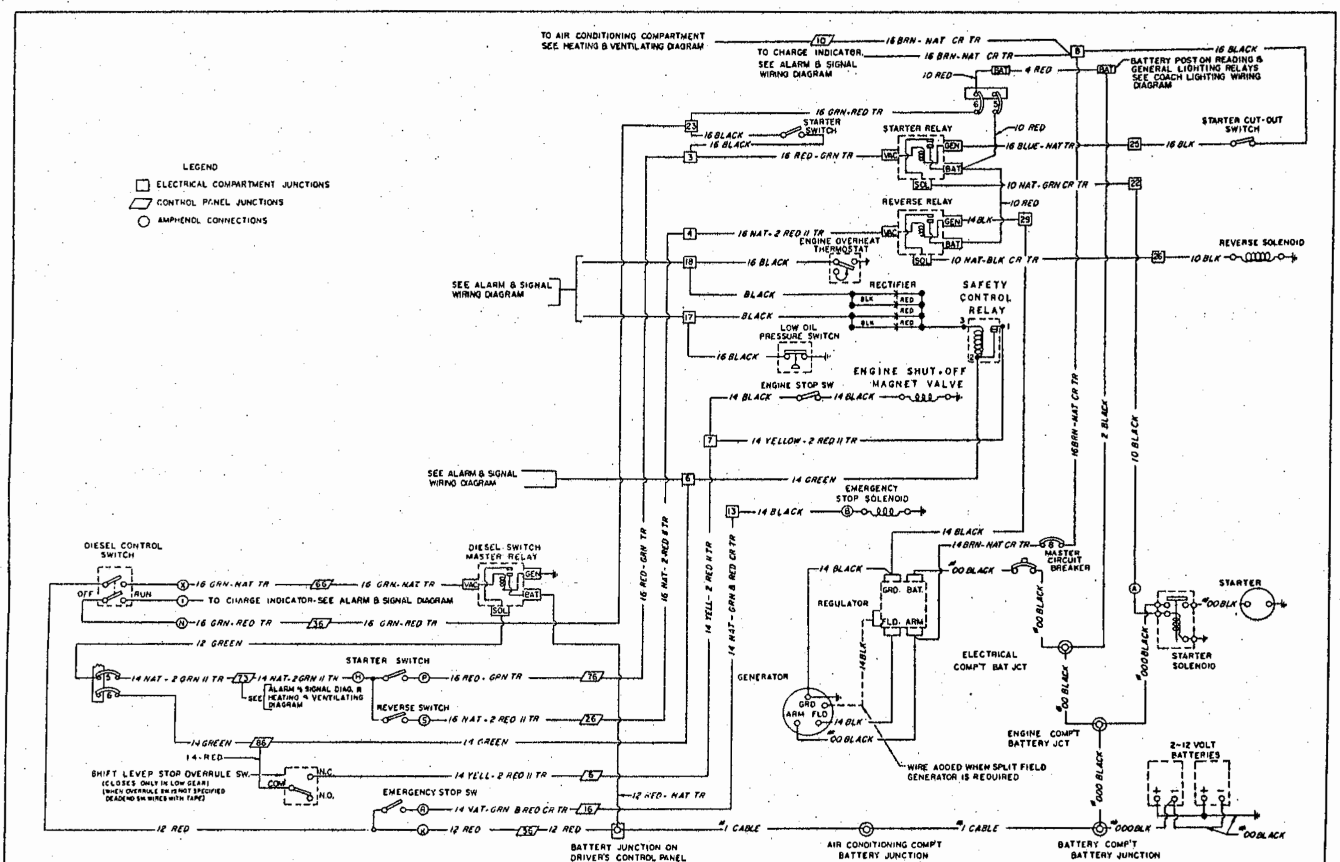
LUBRICANT SYMBOLS

E - Engine Oil
ES - Engine Oil - Special
MP - Multi-Purpose Gear Lubricant
MPG - Multi-Purpose Grease
C - Chassis Lubricant
S2 - 15% Sodium Soap Grease
S3 - Petrolatum - Petroleum Jelly
S13 - Air Filter Fluid
S19 - Automatic Transmission Fluid - Type A



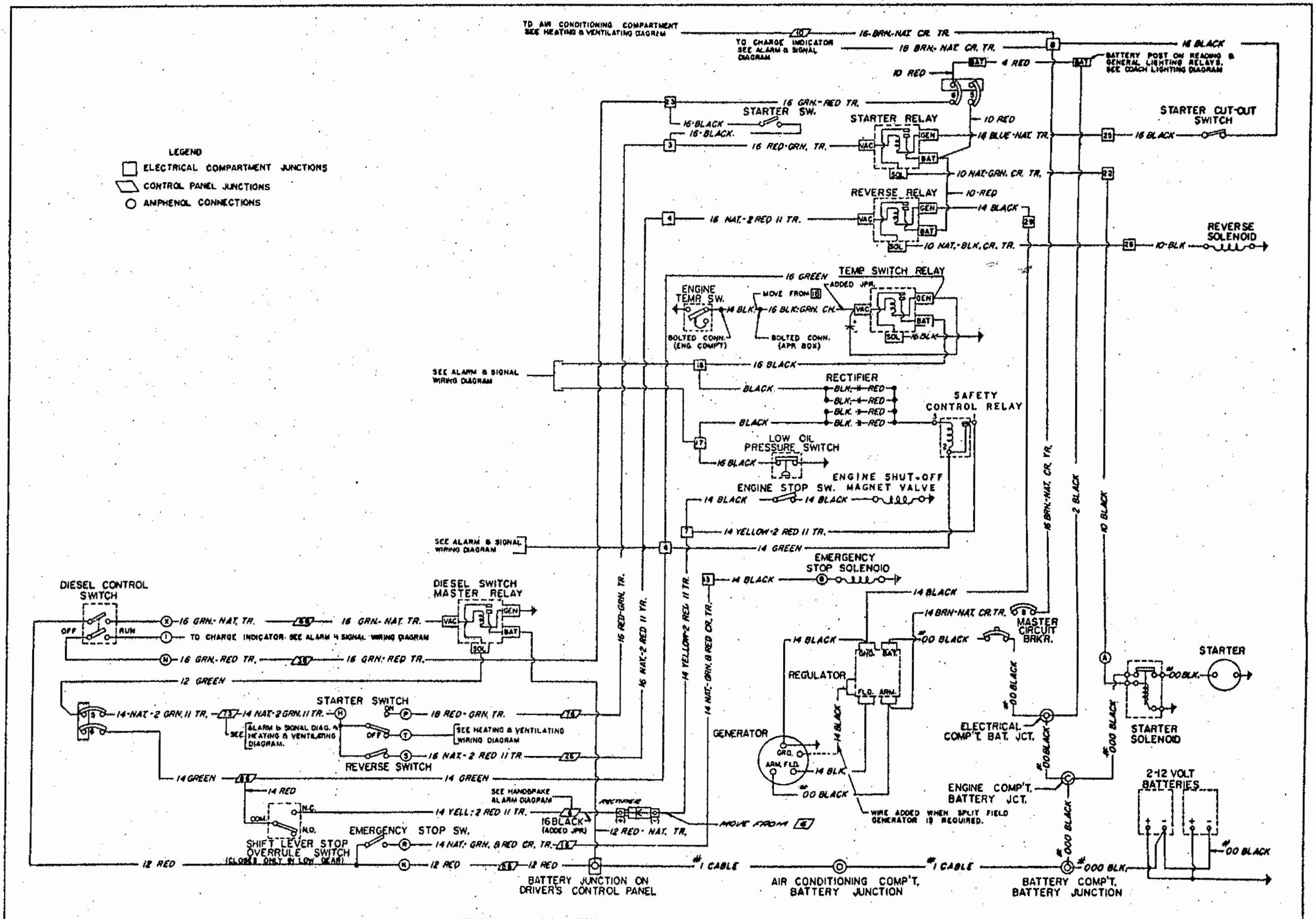
ENGINE CONTROL AND GENERATOR WIRING DIAGRAM - STANDARD

TPM-5500
MD-75606C



ENGINE CONTROL AND GENERATOR WIRING DIAGRAM - SPECIAL
(AUTOMATIC ENGINE SHUT-OFF WITH OVERRULE)

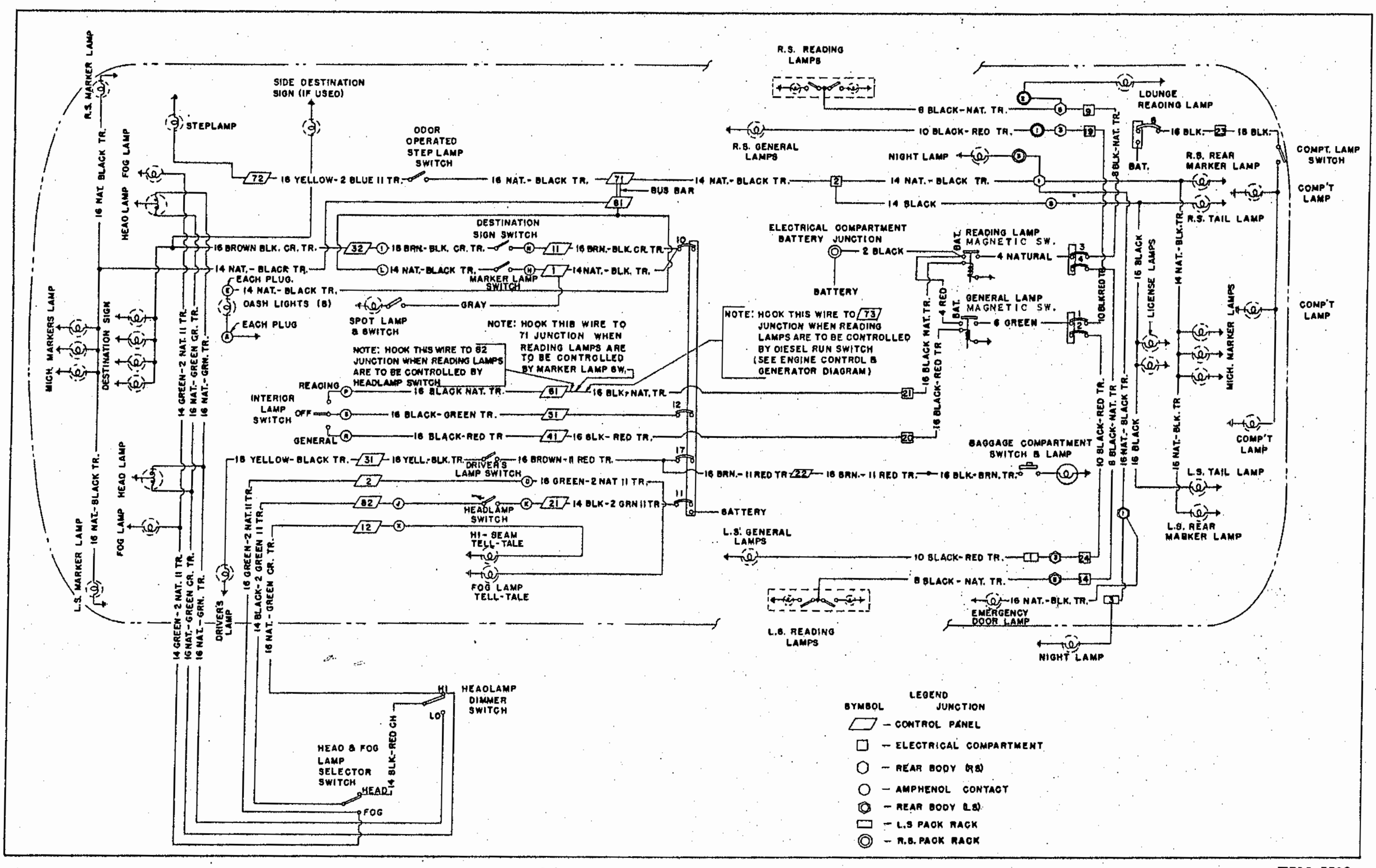
TPM-5501
MD-82893A



X-5814 & X-5818

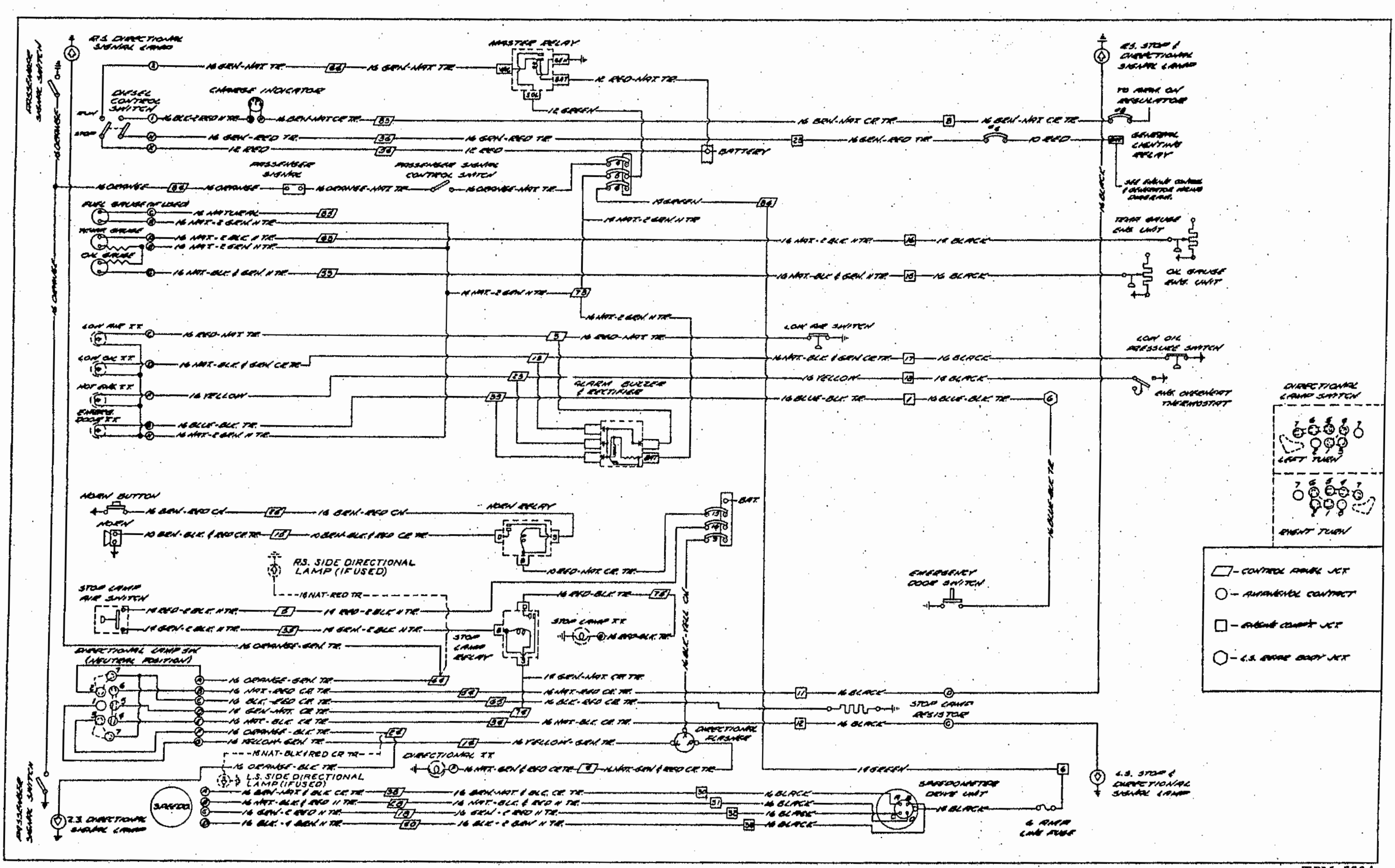
ENGINE CONTROL AND GENERATOR WIRING DIAGRAM - GREYHOUND

TPM-5502
MD-83830J



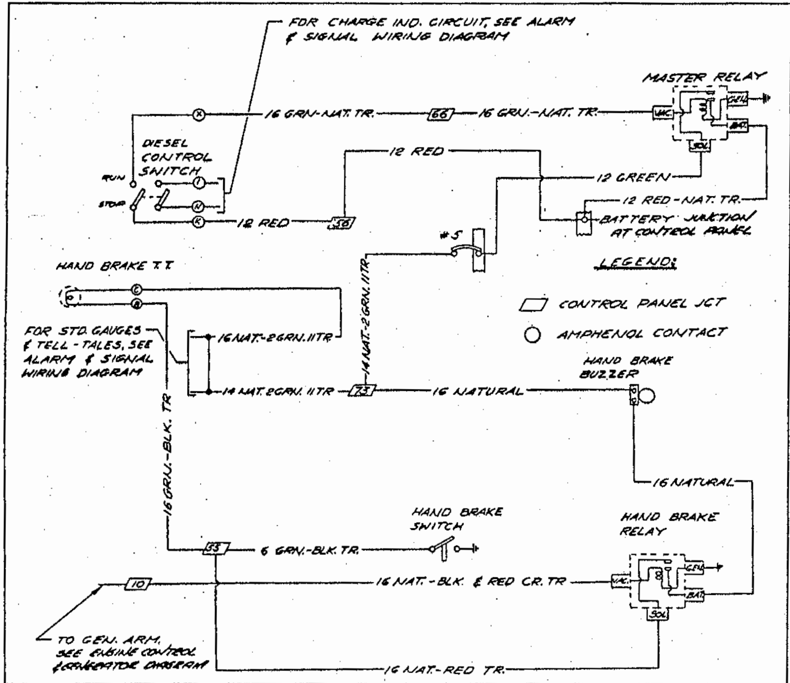
COACH LIGHTING WIRING DIAGRAM

TPM-5503
MD-75571H

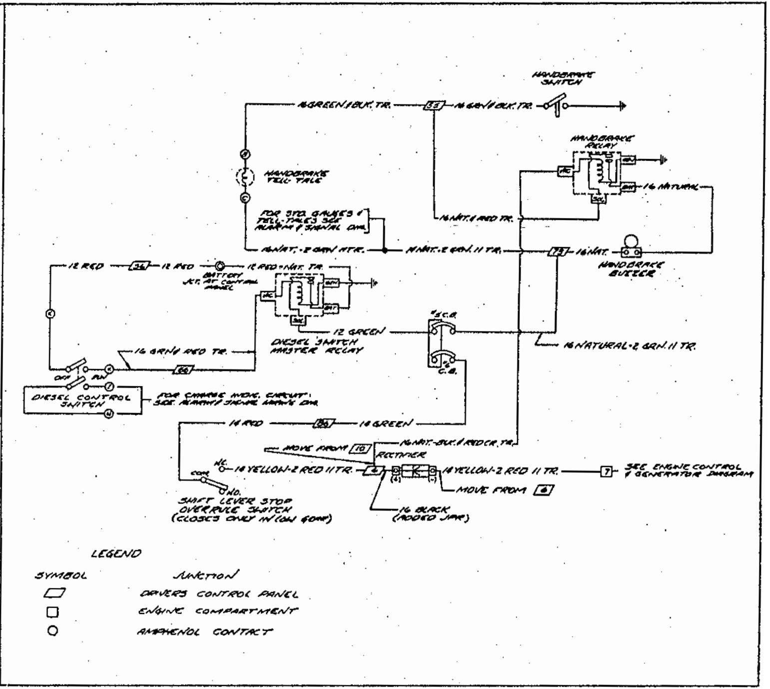


ALARM AND SIGNAL WIRING DIAGRAM

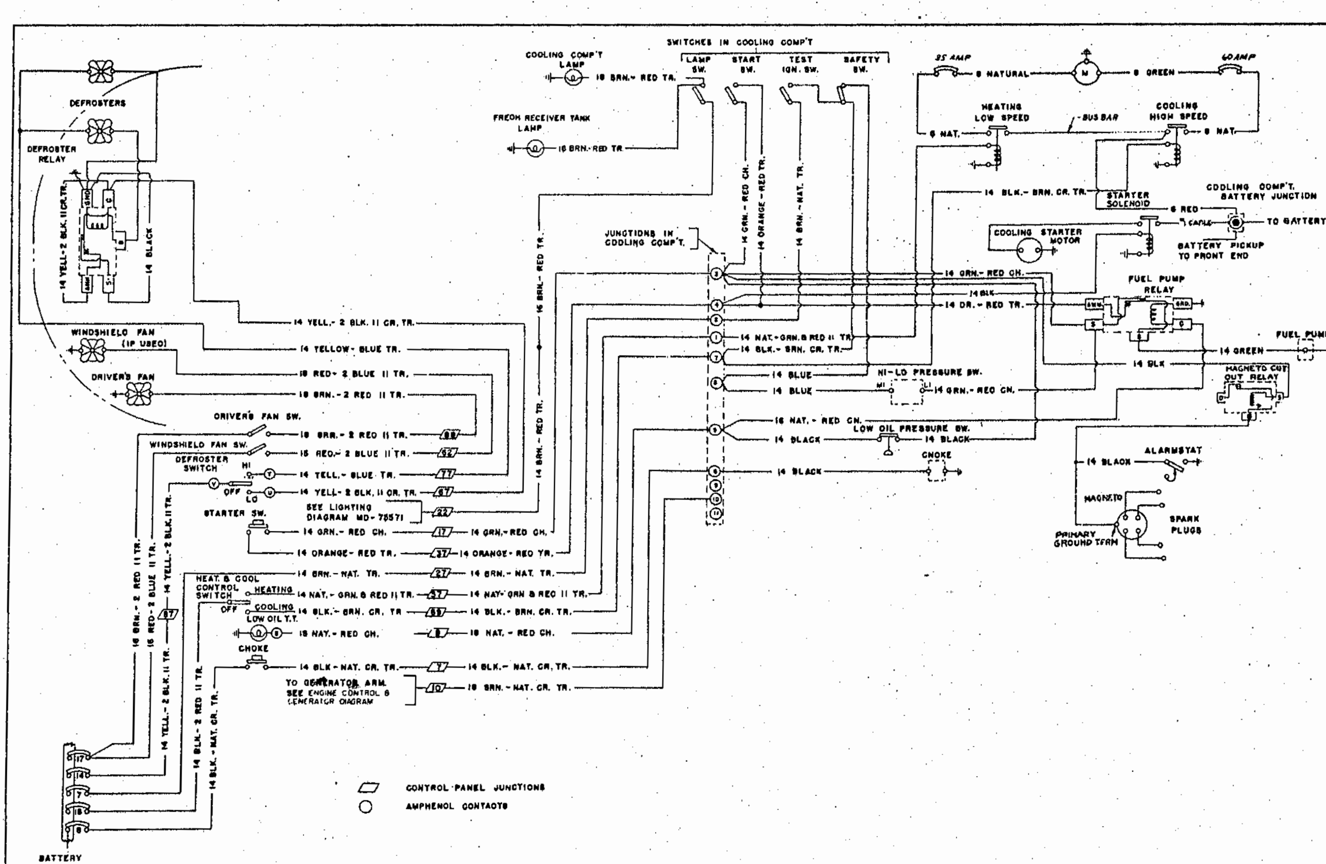
TPM-5504
MD-79109C



TPM 5505

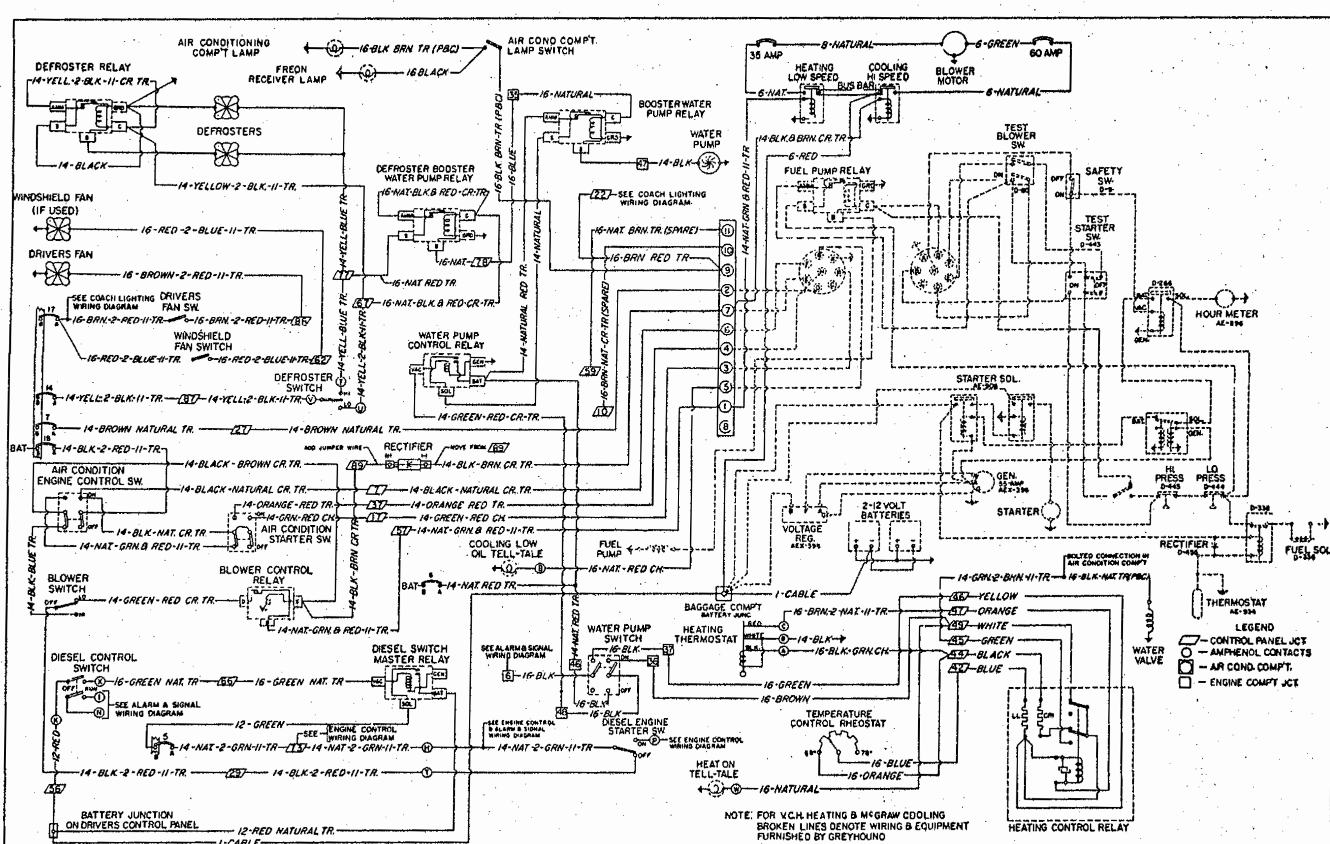


HAND BRAKE ALARM WIRING DIAGRAM - GREYHOUND TPM-5506



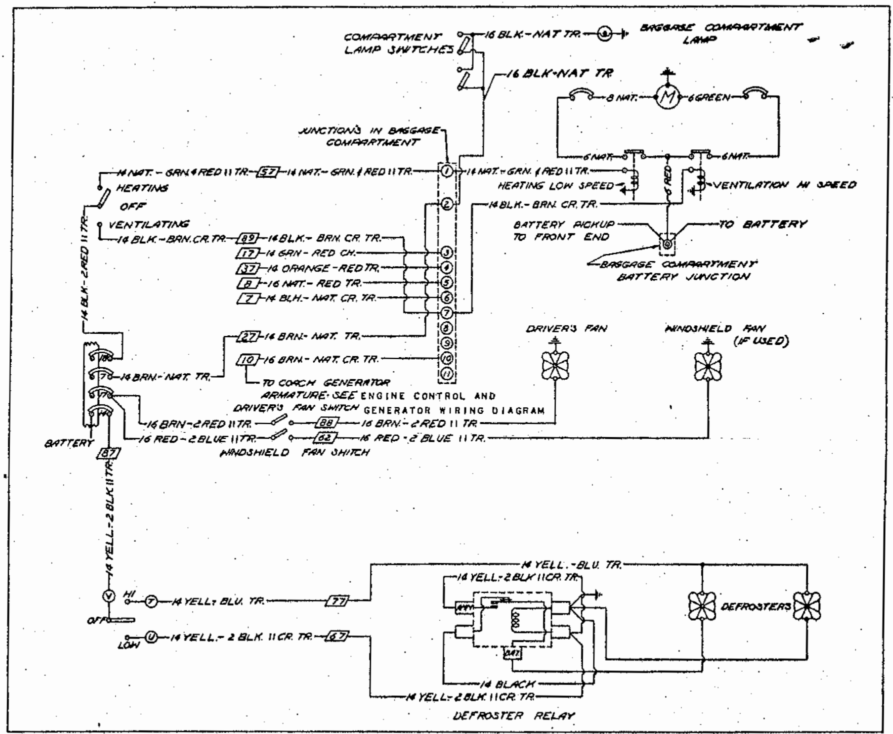
HEATING AND VENTILATION WIRING DIAGRAM - WITH
STANDARD GM AIR CONDITIONING

TPM-5507
MD-77489B



HEATING AND VENTILATION WIRING DIAGRAM - WITH
V.C.H. HEATING AND McGRAW AIR CONDITIONING

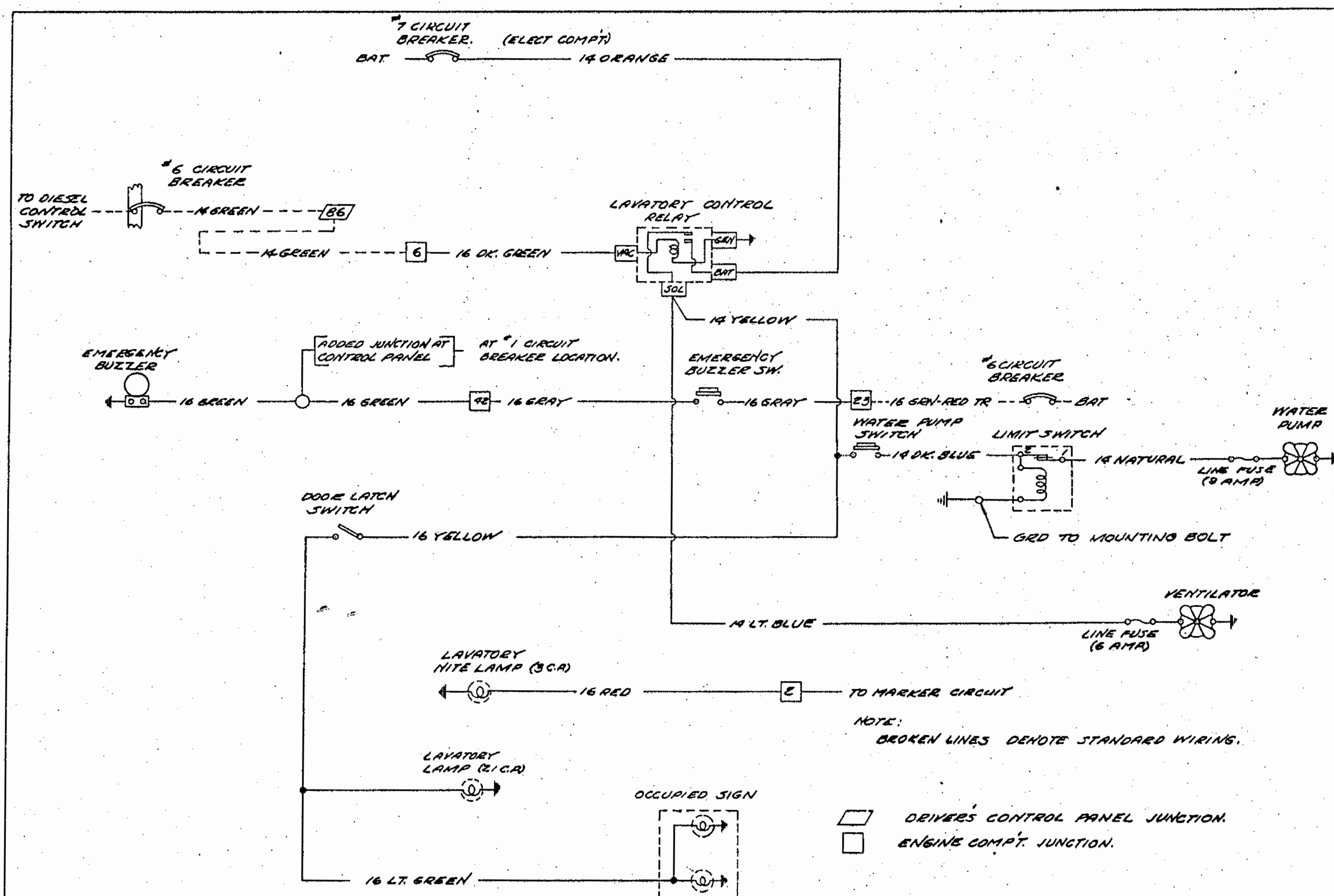
TPM-5508
MD-84005B



X-5814 & X-5818

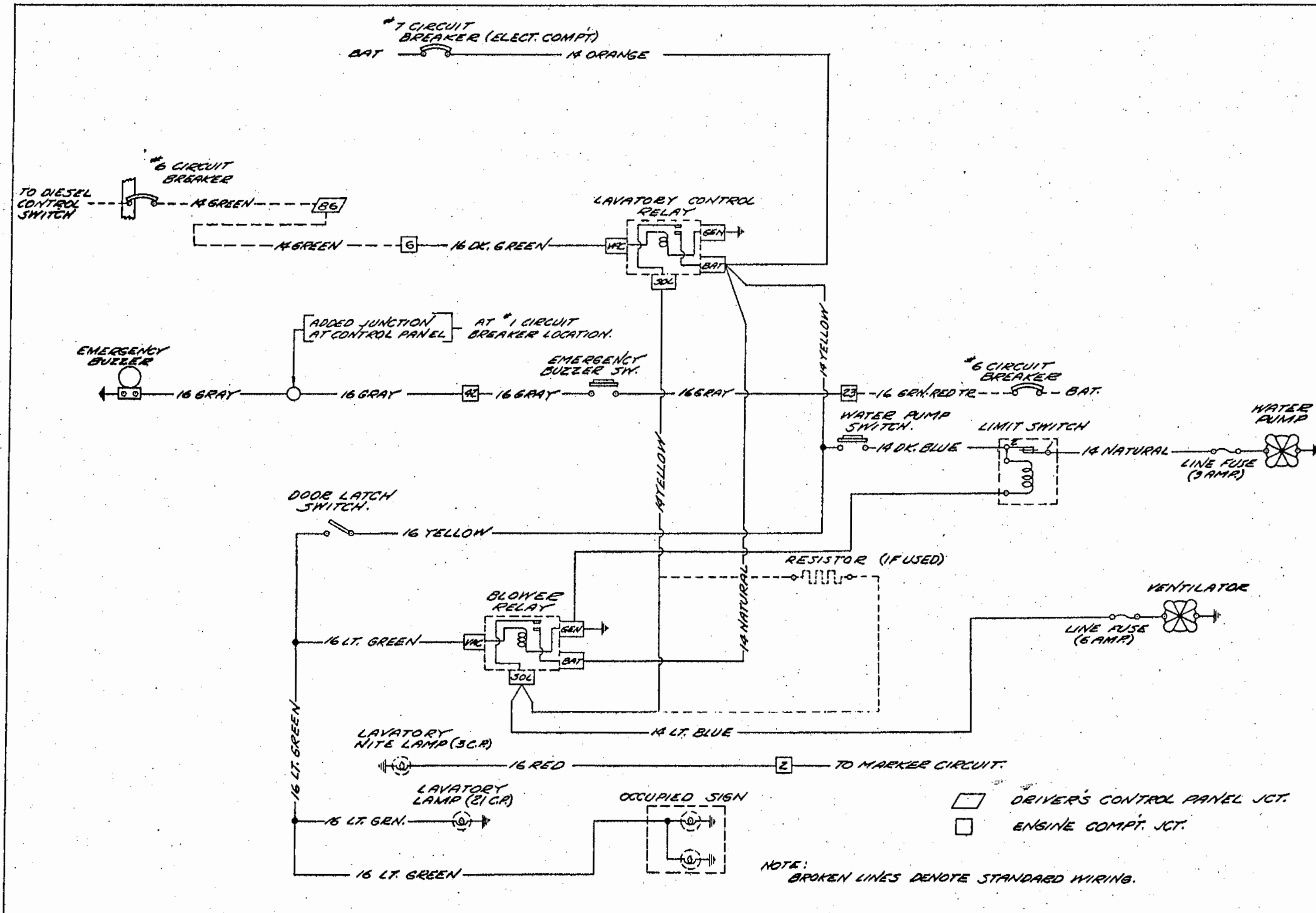
HEATING AND VENTILATION WIRING DIAGRAM - WITH AIR CONDITIONING OMITTED

TPM-5509
MD-75683



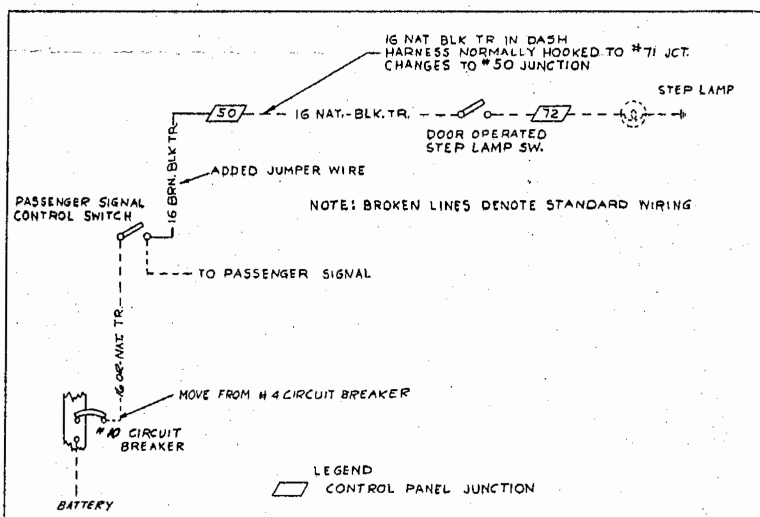
LAVATORY WIRING DIAGRAM - ALL EXCEPT GREYHOUND

TPM-5512
MD-84004



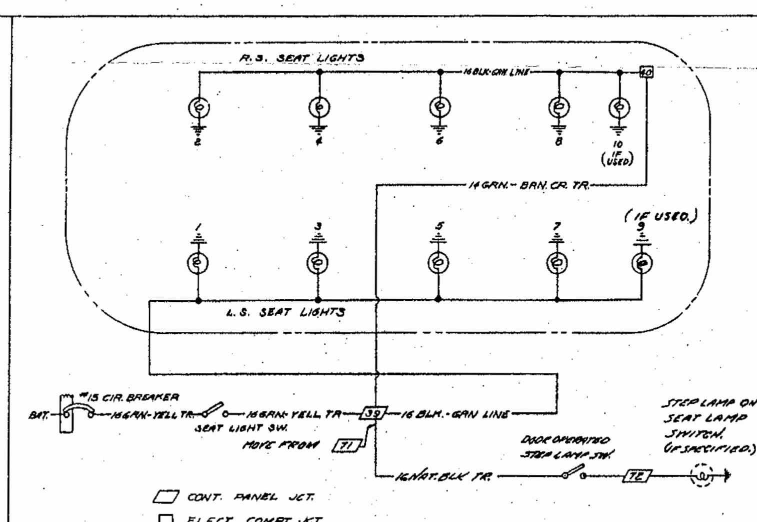
LAVATORY WIRING DIAGRAM - GREYHOUND

TPM-5513
MD-83294A



X-5814 & X-5818 STEP LIGHT WIRING DIAGRAM - SPECIAL

TPM-5510
MD-76189G



SEAT MOUNTED AISLE LIGHT WIRING DIAGRAM - SPECIAL

TPM-5511
MD-75423B